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IN THE UNITED STATES PATENT OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of:

RODNEY M. LAFOLLETTE, ET AL.

Serial No.: 09930,539

Filed: August 14, 2001

For: MICROSCOPIC BATTERIES FOR MEMS
SYSTEMS

)
)
) Docket: 7310.C

)
) Art Unit: 1745

)
) Examiner: RAYMOND ALEJANDRO
)

LETTER OF TRANSMITTAL

Board of Patent Appeals and Interferences
Commissioner for Patents
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Alexandria, VA 22313-1450

Sir:

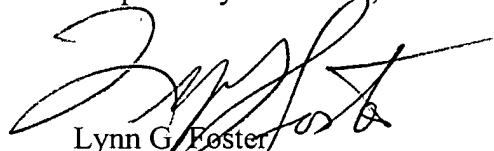
Transmitted timely here with is the Applicant's Appeal Brief and Appendix, each in triplicate, in the above-identified appeal. The Notice of Appeal and the fee required with the Notice of Appeal were timely submitted.

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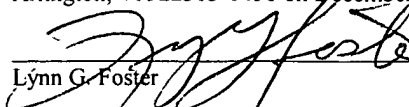
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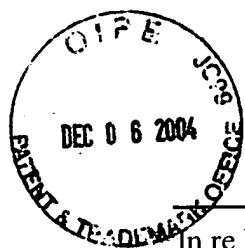

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Examiner: RAYMOND ALEJANDRO

APPEAL BRIEF

Board of Patent Appeals and Interferences
Commissioner for Patents
P.O. Box 1450
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Lynn G. Foster

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I. THE NATURE OF THE APPENDIX

A substantially comprehensive Appendix of relevant documents of record, including a clean copy of the appealed claims, is provided herewith as an aid to the Board of Patent Appeals and Interferences (Board). Each reference to the Appendix contained in this Brief is by page number. For example, a reference in this Brief to the second page of the Appendix is designated "A 2"

II. BASIS OF THIS APPEAL

The basis of this appeal is 37 CFR § 1.191(a).

The Office Action from which this appeal is taken is found at A54.

III. REAL PARTY IN INTEREST

The real party in interest is Bipolar Technologies, Inc., the owner.

IV. RELATED APPEALS AND INTERFERENCES

There is no related appeal at this time.

V. STATUS OF THE CLAIMS

This application is a continuation of U.S. Patent Application Serial No. 09/037,801, filed March 10, 1998.

Claims 121 through 140 are on appeal. (A1-A4) None has been allowed or canceled. All are rejected. Non-elected claims have been cancelled.

VI. STATUS OF AMENDMENTS

There is no outstanding Amendment which has not been entered.

VII. STATUS OF DECLARATIONS

The following Declarations are of record:

Rodney M. LaFollette, Ph.D.

Parent - Rodney M. LaFollette, Ph.D.

Second Parent - Rodney M. LaFollette, Ph.D.

Third Parent - Rodney M. LaFollette, Ph.D.

October 2004 - Rodney M. LaFollette, Ph.D. (A5)

VIII. THE INVENTORS' PROBLEM

Applicants' field of concern is set forth in the present application, at page 1, lines 14 - 20:

Integrated circuits, including microelectronic circuits, have been used extensively, and have the advantage of small size and low production costs particularly when produced on a large scale. A class of integrated circuits that are of particular interest comprise microelectronic circuits having at least one MEMS device. MEMS may comprise complex engineering systems comprising microscopic mechanical elements, such as motors, pumps, relays, sensors, accelerometers and other components, which are powered by electrical energy. MEMS devices make possible controlled physical movement of tiny parts within miniature circuits.

Applicants' problem, within their field of concern, is stated in the present application, at page 2 lines 15 - 21:

While power and energy availability and management are problems for all integrated circuits, they are acute problems for MEMS. Many MEMS devices require periodic power pulses. Conventional wisdom has required and still requires that electrical power be supplied from relatively large, heavy external sources. Moving electrical current into an integrated circuit from such an external power source is difficult, and results in high power losses, particularly for a MEMS circuit where high capacities are required. Additionally, present MEMS devices must be continuously connected to the external power source.

Until the present invention, the provision of an internally integrated battery of sufficient power for a MEMS or like-sized microscopic circuit had remained a long term unsatisfied need, though a huge market therefor had long existed. Application page 3, lines 11 - 16. 10/04 Decl. LaFollette Exh. "B."

IX. THE INVENTOR'S SOLUTION

By applying micro fabricating techniques, rejected or ignored by others for many years in the battery field, the Applicants were, for the first time able to overcome the problems pertaining to long existing use of large external batteries for powering MEMS microscopic circuits and non-MEMS microscopic circuits of the same size. A microscopic battery is provided by the present invention which is fully integratable with such microscopic circuits as a long term internal source of power. As used herein, the term "MEMS" means either a MEMS microscopic circuit or a non-MEMS microscopic circuit of the same size or both.

The prior art did not successfully address the Applicants' problem and all prior art efforts have failed to produce a size and power sufficient integratable internal source of electrical power for MEMS.

Batteries according to the present invention are barely visible to the human eye. A sample is reproduced on the next page.

Note, the Summary of the Invention, in the present application, at page 15, lines 2 - 8:

The present invention involves microscopic batteries, which comprise a very tiny footprint (area), typically on the order of 0.1 cm^2 down to 0.0001 cm^2 , and accommodate direct integration into microcircuits, and/or MEMS, either on a retrofit or unitarily with the microcircuit and MEMS at the time of manufacture. The microscopic batteries of the present invention provide a solution to long existing MEMS energy and power management problems of the past, and will significantly enable MEMS technology for increased utilization. The present invention also involves novel methods of making microscopic batteries.

RECTANGLES ARE MICROSCOPIC BATTERY CELLS
(ACTUAL SIZE)



X. THE OBJECTIONS ARE MOOT

The Examiner's objections (A58) to claims 23 and 33 are now moot in light of amendments made to those claims prior to the appeal.

XI. THE 35 U.S.C. § 112 SECOND PARAGRAPH REJECTION IS MOOT

The Examiner's 35 U.S.C. § 112 second paragraph, rejection (A59) of claims 21-40 is now moot in light of amendments made to the claims prior to the appeal.

XII. GROUPING OF CLAIMS

The appealed claims (Claims 21 through 40) (A1 - A4) to a very large extent do not stand or fall together, although some of the required analysis by the Board may be collective. However, because the claims have limitations the scope of which varies from claim to claim, independent determination by the Board is needed regarding patentability of the various limitations of the appealed claims. Also, reliance in the Office Action (A54) is placed by the Examiner on one reference (Bates) under § 102(b) as to some claims, and on two references (Bates and Miekka) under § 103(a) as to some of the claims rejected under § 102(b) and other claims as well, which creates a further need for separate consideration of the claims.

A number of claims can and will be grouped and analyzed together. However, when a more focused analysis is required little, if any, grouping can take place. In the sections of this Brief which follow, the grouping of certain claims occurs, for purposes of argument only. Nevertheless, the Board is asked to rule separately on the patentability of each appealed claim.

XIII. THE ISSUES

1. Are appealed claims 21-31, 33-36 and 38-40 anticipated by Bates (5,455,126) under 35 U.S.C. § 102(b)?
2. Are appealed claims 26-28, 32 and 37 made obvious under § 103(a) based on Bates in view of Miekka (6,045,942)?
3. Is the Examiner's hindsight reconstruction reversible error?
4. Did the Examiner reversibly err in: (a) failing to meaningfully consider and give an appropriate weight to Applicants' evidence concerning primary and secondary considerations, (b) in refusing to start anew and weight the Examiner's evidence against the Applicants' evidence rather than to pit Applicants' evidence against the Examiner's earlier conclusions, and (c) in relying on his erroneous technical notions, which are not evidence, in wanton disregard of highly relevant and competent evidence of record?

XIV. THE § 102(b) REJECTION

Appealed claims 21-31, 33-36 and 38-40 were rejected in the August 5, 2004 Office Action (A54) under 35 U.S.C. § 102(b) as being anticipated by Bates et al. 5,455, 126..

XV. THE § 103(a) REJECTION

Appealed claims 26-28, 32 and 37 were rejected in the August 5, 2004 Office Action (A54) under 35 U.S.C. § 103(a) as being unpatentably obvious over Bates et al. 5,455,126, as applied to claim 30 above, and further in view of Miekka et al. 6,045,942.

XVI. THE EXAMINER MISCONSTRUES BOTH REFERENCES

Using prohibited hindsight and making himself an unreliable fact witness, the Examiner, in the Office Action mailed August 8, 2004, misconstrued the Bates and Miekka references and assigned features, characteristics, functions and structure and found compatibility and combinability between the references where none exists, The Examiner, without support, contends:

1. “*Bates . . . disclose a . . . microfabricated battery.*” (A60).
2. “[T]he [Bates] electrodes are etched” (A61), even though Bates discloses a deposition only approach.

. . . these fabrication [Bates’ deposition only] techniques is capable of producing a patterned or designed material by eating into the material surface as required by action of etching. Thus, the electrodes are etched. (A61.)

3. “[T]he electrode layers [of Bates] are conductive.” (A62.)
4. *[T]hin batteries stand for flat cells as well as having the battery fabricated onto the semiconductor chip implies having the battery attached thereto (peg in a block). In addition, battery geometries including: the flat cell, spirally wound, bipolar and linear; and wire-shaped, odd-shaped; wire in a can; peg in a block encompasses a very large number of possible permutations of battery configurations.* (A62.)
5. *[I]t would have been obvious to one skilled in the art at the time the invention was made to use the specific liquid electrolyte material and the specific electrolyte influent flow path of Miekka et al in the thin-film battery of Bates et al as Miekka et al teach that the specific **aqueous electrolyte** is chosen based on the overall chemistry required by the battery and which cooperatively participated **to produce the desired electrochemical reaction**. In addition, the specific electrolyte influent flow path is required to make the battery operational, and it may be employed with other battery embodiments as will be appreciated by those of skill in the art, including may of the battery embodiments disclosed therein.*

*As to the specific electrode materials, it would have been obvious to one skilled in the art at the time the invention was made to use the specific electrode materials of Miekka et al in the thin-film battery of Bates et al as Miekka et al teach that it would be readily appreciated that **the active electrode material** are such materials*

or combinations thereof which cooperatively participate to produce the desired electrochemical reaction, wherein the cathode electrode includes a material which acts in the overall system as an oxidizing agent and the anode electrode includes an active material that is easily oxide and thus functions as an available source of electrons, and thus, the claimed electrode materials exhibit the aforementioned properties.

As to the specific battery geometry, it would have been obvious to one skilled in the art at the time the invention was made to use the specific mattery geometry of Miekka et al in the thin-film battery of Bates et al as Miekka et al teach that the anode to cathode electrode geometry may take one of many forms for ease manufacturing. Thus, Miekka et al envision varied battery geometry so as to improve manufacturing thereof.

It is also noted that Bates et al and Miekka et al are pertinent to each other as well as to applicant's invention as they both share the same field of endeavor of providing working functional thin-film micro-sized batteries. (Emphasized.)

XVII. ANALYSIS OF THE PRIOR ART RELIED UPON

A. ANALYSIS OF BATES

Rodney M. LaFollette, Ph.D., one of the present inventors, is a foremost expert in sophisticated extreme miniature battery technology (A5) and provides the expert testimony set forth below.

Bates (5,455,126) is not enabling because it admits to a disclosure need for Figures 1, 2A-2D, 3, 4A, 4B and 5, but the 5,455,126 ('126) patent comprises no drawings at all. However, Bates '126 is a division of U.S. 5,338,625 ('625), which does include the Figures. For ease of reference, the '625 patent (A142) is analyzed below as if it were the '126 patent. (A13)

Bates discloses a "thin film battery" Column 2, line 46. Bates '625 indicates his battery may be a 1992-sized "microbattery" (Abstract, line 2) or a 1992 "macrobattery" (Column 2, line 34). (A13, A142)

The Bates' battery is a "lithium microbattery" Column 5, line 26. More specifically at Column 3, lines 2-7, Bates '625 states his battery comprises deposition steps only. (A14)

Four depositing steps and no removal steps are taught by Bates. Microfabrication requires removal of unwanted material. It is impossible for any Bates battery to be integratable with a MEMS circuit. (A14)

Because of inoperability consideration, Bates provides strict limitations to his invention, i.e. the lithium used for the electrolyte layer must be amorphous not crystalline in order for the level of conductivity to be adequate. Column 4, lines 31-39. Similarly, the cathode must be of amorphous vanadium oxide. Column 3, lines 49-52. (A14)

In terms of size, the Bates Li-VOx cell is 8 microns thick and covers an area of 1 square centimeter. Column 3, lines 31-32. The smallest cells made by Bates were 1 cm² ; others were larger. (A14)

In reference to the Figures of Bates '625, a 1992 semiconductor chip 16 is shown as having been previously made and mounted on a package 12 in Figure 1. Thus, the chip 16 and the Bates battery are not simultaneously formed and, therefore, are not integrated. Adjacent to, but not on, the chip 16 is formed a Li-VOx battery cell 10, having thickness of 8 microns and a 1 square centimeter area. Because battery cell 10 is not formed at the time the chip is formed, but the later, cell 10 is not an internal power source, but an external one requiring connection to the chip 16 using external wire leads 14. (A15)

The nature of the deposition only battery of Bates '625 is apparent from claim 1. (A149) Claim 1 of Bates '126 is more limiting, requiring "*optically transparant*" layers, i.e. an anode, electro chronic material, electrolyte and cathode. (A16)

The Bates process does not and can not make microscopic batteries integratable with MEMS because: (1) the resulting Bates battery is too large; (2) Bates teaches his battery is external to the device being powered requiring wire leads 14; (3) the high temperatures required to create the Bates battery would destroy the MEMS circuit, if made simultaneously, making the MEMS useless; and (4) Bates constraints his batteries to lithium and to a deposition (additive only) thin layer approach and does not teach a battery obtained from patterning from use of microfabrication techniques, among other reasons. (A17)

Bates does not propose etching or any other form of patterning by which unwanted material is selectively removed. (A17)

Failure by the USPTO to apply battery expertise in rejecting the appealed claims under § 102 and § 103 is indicated by the following clearly erroneous statements:

- a. Electrolyte is “reaction accommodating”. (The reactions occur at the electrode material/electrolyte interface, or in the interior of the active material, not in the bulk of the electrolyte. The electrolyte merely serves to conduct lithium ions between electrodes, and prevent physical contact between electrodes.)
- b. The “batteries can be scaled down for microelectronics applications, a size that frequently is many times larger than the semiconductor chip on which they are used.” (This refers to other lithium battery technologies, i.e. non-rechargeable (primary) lithium button cells sold commercially, to power cameras, watches, and other small electronics. These button cells (~1-2cm² typically) are many times larger than the semiconductor chip. This is what

Bates is referring to, rather than the Bates battery.)

- c. “Bates also discloses the fabricating technique may include rf or dc magnetron sputtering, or diode sputtering or cold pressing or lithographic techniques . . . [t]hus, it is noted that any of these fabrication techniques is capable of producing a patterned or designed material by eating into the material surface as required by action or etching. Thus, the electrodes are etched.” (A17)

Patterning is not taught or used by Bates. Patterning, excluded by Bates, must have a low enough resolution (micrometer range typically) to *selectively* remove unwanted material. Bates only teaches a global additive approach. Bates does not teach the patterning for micro-scale feature size, and does not teach etching at all, and certainly not of micro-scale features. Bates does not disclose any *subtractive* process (one that “eats into material,” using the Examiner’s language). (A18)

“Lithography,” is misused by the Examiner. Bates was using the term to define the size of the Bates battery, i.e. “*sizes* achievable with present lithographic techniques”. Bates does not disclose use of lithographic processes to make the Bates battery. (A19)

The Examiner incorrectly states, “*the electrode layers are conductive.*” The active material in the cathode is very poorly conductive. If very thick, the battery would cease to operate effectively. Contrary to the express position of the Examiner, the current collectors 18 and 20 do not make the electrode layers conductive. In fact, the active material of the cathode is very poorly conductive. (A19)

The Examiner further inaccurately asserts that the battery geometries for microfabricated cells of the present invention, are anticipated by Bates. This is absolutely untrue. Bates does not

disclose nor envision, a battery made by Microfabrication, and certainly not to create “peg in a block,” “wire-in-a-can,” or spirally wound cells. (A19)

A battery integratable or integrated with a MEMS or like sized microcircuit is not possible using the Bates technology. (A19)

While the term “microbattery” is used in a number of diverse ways in the literature, in the context of the present application, “microbattery” is used to mean a very tiny battery, made by micro-fabrication, so small that it is integrated or integratable with a MEMS circuit to provide sufficient power to the MEMS. The Bates technology can not be used to do this. (A20)

Contrary to the Examiner’s position, the Bates battery is clearly not integrated nor integratable with semiconductor 16. (A20)

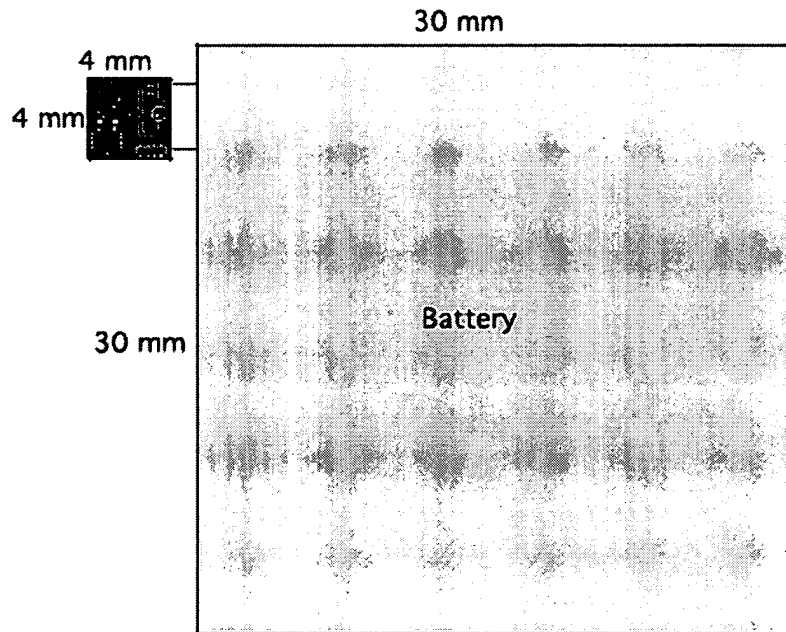
There are two primary reasons that the thin-film battery of Bates, and other prior art thin film batteries, cannot be integrated. The first is due to the chemical and thermal conditions necessary to make the batteries. (A20)

The Bates battery cannot be integrated, as the processing conditions needed for the Bates battery (temperatures $> 400^{\circ}\text{C}$ for extended time) would destroy a microcircuit. The Bates battery must be made separately and used separately as a non-integrated component, that is attached to the circuit with wire leads. As stated by M. Madou, *Fundamentals of Microfabrication*, 1st Ed., CRC Press, New York, N.Y., p. 442., in reference to the work of Bates,

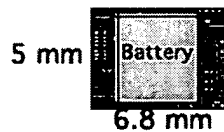
Often the thin film materials deposited in constructing these batteries, such as Li , TiS_2 , V_2O_5 , etc., *prove to be incompatible with the IC process, and the prospect of integrating them with ICs seems remote* (Italics added). (A20, A174)

The second reason that the battery of Bates as well as other thin-film solid state batteries cannot be integrated, is physical (i.e. the relative sizes of the battery and circuit). The Bates battery

could conceivably be used to power a MEMS, as a separate large wire connected power source. However, the size of the battery to provide adequate power would make this impractical. Figure “a” below shows the size of a Bates battery that would be needed for a typical MEMS, while Figure “b” shows the size relationship between a battery according to the present invention and a typical MEMS. (A20)



a. Accelerometer Circuit with Thin-Film Bates Battery.



b. Accelerometer Circuit Incorporating our Microscopic Battery.

(A21)

B. ANALYSIS OF MIEKKA

Miekka (U.S. 6,045,942) does not teach patterning, only deposition (with no partial layer removal via etching or in some other way). The disclosure calls for creation of an ultra thin primary battery, but does not characterize the area nor the volume as being small. A large area would be involved in order to produce the energy levels necessary for operative use and to use the disclosed method. (A22)

In respect to Figure 2, the ultra thin, low profile, low cost battery comprising "planar" electrodes is formed using the following steps:

1. A layer of conductive ink 54 is printed, at station 46, on a thin non-conductive polymeric sheet 38 extending and displaced between rollers 36 and 42;
2. A conductive powder 56 is sprinkled by gravity and vibration, at station 48, on the uncured ink layer 54 and, if necessary, pressing the conductive powder into the uncured ink layer 54 using a roller 64;
3. The ink layer 54 with embedded powder 56 is cured, at station 50;
4. Residual loose conductive powder 56 is removed from the top of the cured ink layer 54, presumably using a vacuum at station 52.

The conductive powder 56 is the active electrode material. (A22)

Aqueous electrolyte is placed in a porous separator disposed between the cathode and anode in any one of several configurations shown in Figures 1 and 3-6. (A22)

The ultimate area of the thin battery must be quite large because to displace the non-conductive thin polymer film 38 between rollers 36 and 42 would require film 38 to be of substantial

width. (A22)

The "printing" at station 46 appears to be via an ink roller. (A23)

The anode is preferably zinc and the cathode preferably copper oxide or silver oxide, while the aqueous electrolyte is preferably potassium hydroxide. (A23)

Miekka discloses a specific process used to make thin-film PRIMARY (non-rechargeable) batteries. That process involved the application of a conductive ink (such as in a printer), and then placement of powdered active materials into the (still-wet) ink. Various cell geometries are disclosed, most with an unequal number of cathodes and anodes (for example, one cathode and two dissimilar anodes, so as to be able to deliver two different voltages, depending on which anode is used). Miekka does not cover any other type of battery fabrication process. Miekka does not disclose microfabrication of a battery, because no unwanted material is removed. (A23)

The Examiner erroneously asserts that it would have been obvious to anyone skilled in the art to make use of the specific liquid electrolyte material of Miekka (aqueous potassium hydroxide) and flow path "in the thin-film battery of Bates." This is technically very much off target. Anyone even modestly skilled in the art of batteries would know that exposure of the electrode materials of Bates to a water, would ruin the Bates cell and render it inactive and perhaps dangerous. Further, the external electrolyte reservoir is only useful for extending the shelf-life of an aqueous battery, and is not needed in the solid-state battery of Bates, which (if properly constructed) is stable for years, even with their electrolyte in the cell. (A23)

The Examiner incorrectly states:

that "it would have been obvious to one skilled in the art at the time the invention was made to use the specific electrode material of Miekka et al. in the thin-film battery of Bates et al. as Miekka et al. teaches that it would be readily appreciated

that the active material are such materials or combinations thereof which cooperatively participate to produce the desired electrochemical reaction....”

On the contrary, anyone with even mediocre skill in battery art would know that Miekka is referring to aqueous electrolyte batteries, and that the non-aqueous, non-liquid battery of Bates would be destroyed in the presence of water. (A24)

The electrode active materials of Miekka would not “produce the desired electrochemical reaction,” as the materials of Bates are “insertion” compounds, such as LiCoO_2 , LiMn_2O_4 or LiNiO_2 . The reaction mechanism is different than the electrode materials used in aqueous batteries, such as mentioned by Miekka. Normal battery materials, such as used in aqueous batteries (lead-acid, nickel-cadmium, etc.) go through chemical reactions during charge and discharge. In other words, the starting materials are converted to a different compound. For example, lead metal in the negative of a lead-acid battery is converted to a lead sulfate on discharge. In a lithium-ion battery, the electrode materials operate on a different principle. Rather than undergoing a chemical reaction and subsequent phase change, the materials retain their same structure when charged and discharged. During battery operation, lithium ions are inserted or removed from the crystal lattice of the active materials. None of the materials mentioned by Miekka would be suitable electrode materials in a lithium-ion battery, such as Bates. Also, the operating voltages of Miekka would be much lower than with the materials used by Bates. (A24)

The Examiner erroneously states that the battery of Miekka could be made using the Bates process. This is simply untrue. Miekka discloses a very narrow processing approach, using the inks, etc. Use of an aqueous electrolyte is also disclosed. The process of Bates is utterly incompatible with water. In fact, the battery process is performed in a desiccated environment. (A25)

In error, the Examiner also states,

“It is also noted that Bates and Miekka are pertinent to each other as well as to the applicant’s invention as they both share the same field of endeavor of providing working functional thin-film micro-sized batteries.”

Bates and Miekka do not disclose micro-sized integratable MEMS batteries. Furthermore, it is a nonobvious stretch to assert that Bates and Miekka are pertinent to one another. About the only thing that they have in common are thin-film construction (although Miekka is much thicker than Bates). Other than that, their processes are incompatible. Their chemistries are incompatible. Bates discloses a rechargeable battery; Miekka discloses a primary battery. (A25)

Thus, Miekka and Bates are not compatible and not combinable.

In summary, the presently pending elected claims are not anticipated by Bates alone or made obvious by Bates together with Miekka because Bates does not teach microfabrication, is comparatively huge, prohibiting MEMS integration, and Bates and Miekka can not be combined, among other reasons. (A26)

Until the present invention, no one of ordinary or extraordinary skill recognized, over a period of many, many years during which the need existed that a tiny microscopic battery could be microfabricated so as to be size compatible and integratable with a MEMS or similarly sized microcircuit and still have sufficient electrical power to properly drive the MEMS circuit. Thus, the present discovery, including its methodology, is not anticipated nor obvious to those having skill in the battery field. The present invention, for the first time provides a battery fully integratable with a MEMS or MEMS-sized circuit, a feat never heretofore accomplished, which has great technical and commercial significance. (A26)

XVIII. THE ARGUMENT

A. THE ESSENCE OF THE INVENTION

The essence of the present invention solves a long standing problem and comprises a microscopic battery, much much smaller than any other battery characterized as being a microscopic battery. The claimed invention must be microfabricated and integratable with and power adequate for a MEMS. The above-mentioned essence of the invention is clear from the language of the appealed claims. Note, for example, also the size limitation in claims 21-32 of “footprints [areas] as low as 0.001 cm²” and in claims 33-40 of a “footprint [area] within the range of less than 1 cm² to 0.001 cm².”

The prior art is absolutely incapable of providing a tiny, tiny battery integratable with a MEMS for providing sufficient power to drive the MEMS.

B. THE § 102(b) REJECTION IS ERRONEOUS

Until the present invention, notwithstanding the existence for a very long time of micro-fabrication for MEMS-sized circuits, scientists of ordinary and extraordinary skill were unable to find a way to provide any tiny battery capable of being integrated with and having enough power to drive the MEMS. (A30, A39, A41, A42).

Bates’440 and Bates ‘625 do not address nor solve Applicants’ problem, i.e. the use of large, heavy and bulky external sources of electrical power to drive MEMS circuits. In fact Bates is an external, not an internal, source of power for a semiconductor. The potential market for a tiny, integratable, internal source of sufficient electrical power for MEMS has, for many years been an unaddressed multi-million dollar market. (Application @3).

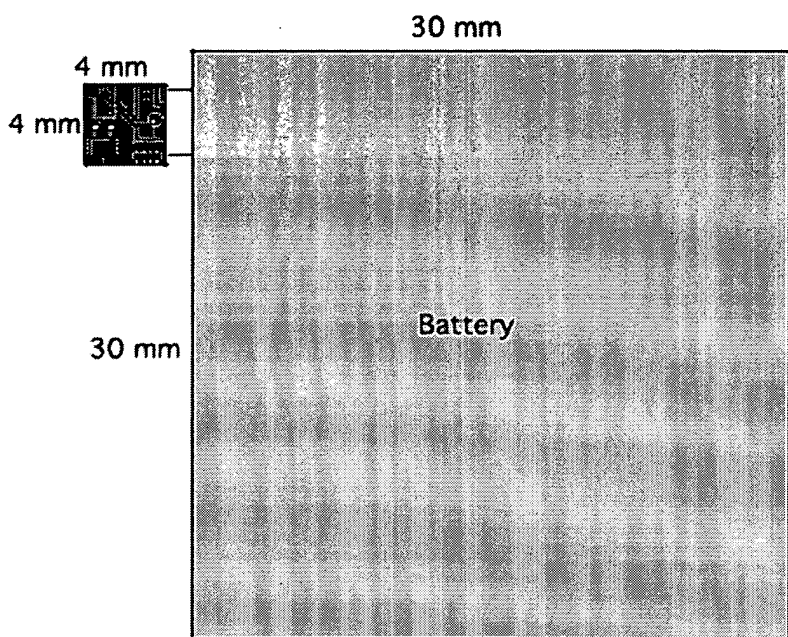
It is impossible to manufacture a battery integratable with and capable of powering a MEMS using the Bates technology. Dr. LaFollette accurately declares, at A20, A21:

There are two primary reasons that the thin-film battery of Bates, and other prior art thin film batteries, cannot be integrated. The first is due to the chemical and thermal conditions necessary to make the batteries.

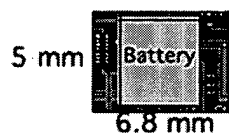
The Bates battery cannot be integrated, as the processing conditions needed for the Bates battery (temperatures $> 400^{\circ}\text{C}$ for extended time) would destroy a microcircuit. The Bates battery must be made separately and used separately as a non-integrated component, that is attached to the circuit with wire leads. As stated by M. Madou, *Fundamentals of Microfabrication*, 1st Ed., CRC Press, New York, N.Y., p. 442., in reference to the work of Bates,

Often the thin film materials deposited in constructing these batteries, such as Li , TiS_2 , V_2O_5 , etc., *prove to be incompatible with the IC process, and the prospect of integrating them with ICs seems remote.* (Italics added). (A176)

The second reason that the battery of Bates as well as other thin-film solid state batteries cannot be integrated, is physical (i.e. the relative sizes of the battery and circuit). The Bates battery could conceivably be used to power a MEMS, as a separate large wire connected power source. However, the size of the battery would make this impractical. Figure "a" below shows the size of a Bates battery that would be needed for a typical MEMS, while Figure "b" shows the size relationship between a battery according to the present invention and a typical MEMS. (A21)



a. Accelerometer Circuit with Thin-Film Bates Battery.



b. Accelerometer Circuit Incorporating our Microscopic Battery.

Thus, Bates lacks enablement and utility to be power adequate and size integratable with a MEMS, notwithstanding the Examiner's misplaced hindsight effort to reconstruct Bates to fit within the scope of the appealed claim.

Where the MEMS would be heat-destroyed during any attempt at integration with a Bates battery, the “every element” and “every function” mandate of § 102 can not and is not met. See *infra*.

As is clear from the October 2004 Declaration of Dr. La Follette that the smallest battery producible using the Bates technology is much, much larger than that of a MEMS. It is readily apparent from Figures “a” and “b” at A21 is about 60 - 70 times the size of a MEMS in area.

The Bates technology can produce both a 1992 sized microbattery (A13) or a 1992 sized macrobattery (A13), but the smallest area achievable by Bates is 1cm², if the power level is disregarded. (A14). Thin film battery technology does not equate to small (tiny) area battery technology. (A13).

Bates technology is constrained to deposition of material only - no removal of material (by etching, for example). (A14, A15, A16, A18).

Bates concedes non-integration of his battery with a semiconductor. The semiconductor chip is previously made and later the Bates battery is formed and connected to the chip 16 using external wire leads 14. (A15, A17, A143).

Also, Bates ‘126, at claim 1, mandates and is limited to “optically transparent” components. (A16, A17).

Bates teaches away from the claimed technology and has been hindsight reconstructed by the Examiner.

With the facts identified immediately above, in mind, initial reliance on U.S.C. § 102 was misplaced, as such violates and would continue to violate the strict “every element” and “every function” requirements of U.S.C. § 102. Restated, § 102 may be applied to a claim

only when "every element" and "every function" of the claim is found in a single § 102 reference. For example, *Lindemann Maschinenfabrik GMBH v. American Hoist and Derrick Co. et. al.*, 221 USPQ 481, 485 (Fed Cir.1984), which emphasizes the "every element" requirement:

Anticipation requires the presence in a single prior art reference of *each and every element* of the claimed invention arranged as in the claim. *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983); *SSIH Equip. S.A. v. USITC*, 718 F.2d 365, 218 USPQ 678 (Fed. Cir. 1983). In deciding the issue of anticipation, the trier of fact [Examiner] must identify the elements of the claims, determine their meaning in light of the specification and prosecution history, and identify corresponding elements disclosed in the alleged anticipation reference. (Emphasis supplied.)

RCA Corp. v. Applied Digital Data Systems, Inc., 221 USPQ 385, 389 at fn. 5 (Fed. Cir. 1984) emphasizes the "every function" requirement:

Anticipation is determined by comparison of the reference with the claims The limitations which must be met by an anticipatory reference are those set forth in *each statement of the function*. *In re Mott*, 557 F.2d 266, 269, 194 USPQ 305, 307 (CCPA 1977). *Such a limitation cannot be met by an element in a reference that performs a different function*, even though it may be part of a device embodying the same general overall concept. (Emphasis added.)

The Federal Circuit confirmed the forgoing in *Diversitech Corp. v. Century Steps, Inc.*, 7 USPQ2d 1315, 1317 (Fed. Cir. 1988):

For a prior art reference to anticipate in terms of 35 U.S.C. Section 102, *every element* of the claimed invention *must be identically shown in a single reference*. See *Hybritech, Inc., v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 1379, 231 USPQ 81, 90 (Fed. Cir. 1986), cert. denied, 107 S.Ct. 1606 (1987). (Emphasis provided).

Similarly, the Ninth Circuit, in *Scott v. Inflatable Systems, Inc.*, 222 USPQ 460, 461 (9th Cir. 1983), has held:

Anticipation is a technical defense which *must meet strict standards*. *Schroeder v. Owens-Corning Fiberglass Corp.*, 514 F.2d 901, 904, 185 USPQ 723, 725-26 (9th Cir. 1975). "Unless all of the same elements are found in exactly the same situation and united in the same way to perform the identical function in a single prior art reference, there is no anticipation." *Walter v. General Motors Corp.*, 362 F.2d 56, 68 (9th Cir. 1966). (Emphasis supplied.)

Here, as in *Ex parte Murphy and Burford*, 217 USPQ 479, 481 (Bd. App. 1982), the Examiner must consider all of the limitations of the claims. In this regard, *Ex parte Murphy and Burford* holds:

Since *all limitations* of a claim must be considered in determining the claimed subject matter . . . and *it is error to ignore specific limitations distinguishing over the reference*. *In re Boe*, 505 F.2d 1297, 184 USPQ 38 (CCPA 1974).

The Examiner, in making the § 102 rejection, failed to give appropriate weight to functional statements tied to a specific structural means. This is error. As stated in *Ex parte Bylund*, 217 USPQ 492, 498 (Bd. of App. 1981):

. . . contrary to the Examiner's assertions, *functional language* in the claims *must be given full weight and may not be disregarded* in evaluating the patentability of the subject matter defined employing such functional language. (Emphasis provided.)

The foregoing is wholly consistent with MPEP § 2131:

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegall Bros. v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the . . . claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). The elements must be arranged as required by the claim, *In re Bond*, 15 USPQ2d 1566 (Fed. Cir. 1990).

Any attempt to read the present invention, as presently claimed, fully into any single reference, including Bates, does not comport in any way with the actual elements and functions disclosed in any reference of record. Withdrawal of § 102 as a basis for refusing allowance is, accordingly, appropriate and is courteously requested. It is not permissible to reconstruct, rearrange, alter or infer enablement into a reference and still comply with the statutory requirements of 35 U.S.C. § 102.

Bates does not teach all the claimed structure and all the claimed function contained in claims 21-31, 33-36 and 38-40, strict requirements of § 102. Far from it, Bates lacks utility and facts to provide enablement for the limitations of these claims.

Under controlling case law, cited above, it is manifest error to disregard functional limitations in a claim, nor can the specific teachings of a reference be reworked or enablement imagined under § 102 to teach something different from that which is in fact enabled. See *In re Payne et al.*, 203 USPQ 245,255(CCPA 1979). While *In re Payne et al.* is concerned about § 103, the holding thereof applies even with greater force and effect under § 102 because of the “every element” and “every function” mandate. Thus, “a reference must provide an enabling disclosure, i.e....[the reference] must place the claimed invention in the possession of the public”.

While many reasons exist as to why Bates is not a § 102 reference, a major one is demonstrated on page 17 of the October 2004 Declaration of Rodney M. LaFollette, Ph.D., at Figures “a” and “b.” (A21) The smallest battery available using the Bates technology for powering a MEMS is 60-70 times larger than a MEMS. See Figure “a.” (A21) Thus, the Bates battery can not be an internal or integrated source of power for a MEMS, but must be wire connected to the MEMS from an external location. (A143) See Figure “a.” (A21) This is the

very problem addressed and amazingly solved by the Applicants. See Figure “b.”

Furthermore, integral formation of a MEMS and a Bates battery though oversized, would heat destroy the MEMS, rendering the combination unusable and inoperable. (A17, A20).

Bates must be withdrawn as a § 102 reference as not meeting “every element” and “every function” requirement. Claims 21-31, 33-36 and 38-40, improperly rejected under §102(b), are not anticipated and are clearly patentable over Bates. Allowance is courteously invited.

C. THE § 103(a) REJECTION IS ERRONEOUS

The facts and arguments concerning the Bates reference, presented above, are incorporated herein by reference.

Miekka does not teach patterning, only deposition. An ultra thin primary battery is created by Miekka , which is not characterized as being small in area. Miekka, in fact, involves a large area which is necessary to produce the energy levels required for operative use. (A22)

The ultra thin, low profile, low profile battery of Miekka comprises “planar” electrodes is formed by:

Printing a layer of conductive ink 54, at station 46, across the width of a thin wide non-conductive polymeric sheet 38, sheet 38 extending and being displaced between rollers 36 and 42; sprinkling a conductive powder 56 by gravity and vibration, at station 48, on the uncured ink layer 54 and, if necessary, pressing the conductive powder into the uncured ink layer 54 using a roller 64; curing ink layer 54 with embedded powder 56, at station 50; and removing residual loose conductive powder 56 from the top of the cured ink layer 54, presumably using a vacuum at station 52. (A22)

The conductive powder 56 is the active electrode material. (A22)

Aqueous electrolyte is placed in a porous separator disposed between the cathode and anode. (A22)

The ultimate area of the thin battery is quite large because to displace the non-conductive thin polymer film 38 between rollers 36 and 42 would require film 38 to be of substantial width. (A22)

The "printing" at station 46 appears to be via an ink roller station. (A23)

The anode is preferably zinc and the cathode preferably copper oxide or silver oxide, while the aqueous electrolyte is preferably potassium hydroxide. (A23)

Miekka discloses a specific process used to make thin-film *primary* (non-rechargeable) batteries. That process involves applying a conductive ink and placement of powdered active materials into the (still-wet) ink. Miekka does not cover any other type of battery fabrication process. Miekka does not disclose microfabrication of a battery, because, among other reasons, no unwanted material is removed. (A23)

Miekka's external electrolyte reservoir is used in conjunction with a thin-film non-micro-fabricated primary battery, not a microfabricated battery. The Miekka thin-film primary battery, not rechargeable and is not microfabricated. (A23)

The Examiner erroneously asserts that it would have been obvious to anyone skilled in the art to make use of the specific liquid electrolyte material of Miekka (aqueous potassium hydroxide) and flow path "in the thin-film battery of Bates." Anyone even modestly skilled in the art of batteries would know that exposure of the electrode materials of Bates to a water, would

ruin the Bates cell and render it inactive and perhaps dangerous. (A23)

The Examiner incorrectly states that “it would have been obvious . . . to use the specific electrolyte material of Miekka et al. in the thin-film battery of Bates et al. . . .” On the contrary, anyone with even mediocre skill in battery art would know that Miekka is referring to aqueous electrolyte batteries, and that the non-aqueous, non-liquid battery of Bates would be destroyed in the presence of water. (A24)

The powders that Miekka uses as active materials could not be used in the process of Bates. They would not “produce the desired electrochemical reaction,” as the materials of Bates are “insertion” compounds, such as LiCoO_2 , LiMn_2O_4 or LiNiO_2 . The reaction mechanism is different than the electrode materials used in aqueous batteries, such as mentioned by Miekka. Normal battery materials, such as used in aqueous batteries (lead-acid, nickel-cadmium, etc.) go through chemical reactions during charge and discharge. In other words, the starting materials are converted to a different compound. For example, lead metal in the negative of a lead-acid battery is converted to a lead sulfate on discharge. In a lithium-ion battery, the electrode materials operate on a different principle. Rather than undergoing a chemical reaction and subsequent phase change, the materials retain their same structure when charged and discharged. During battery operation, lithium ions are inserted or removed from the crystal lattice of the active materials. None of the materials mentioned by Miekka would be suitable electrode materials in a lithium-ion battery, such as Bates. Also, the operating voltages of Miekka would be much lower than the materials used by Bates. (A24)

The Examiner erroneously states that the battery of Miekka could be made using the Bates process. This is simply untrue. Miekka discloses a very narrow processing approach, using

the inks, etc. Use of an aqueous electrolyte is also disclosed. The process of Bates is utterly incompatible with water, In fact, the battery process is performed in a desiccated environment. (A25)

The Examiner states, “. . . Bates and Miekka are pertinent to each other as well as to the applicant’s invention as they both share the same field of endeavor” Bates and Miekka do not disclose micro-sized integratable MEMS batteries. Furthermore, it is a nonobvious stretch to assert that Bates and Miekka are pertinent to one another. About the only thing that they have in common is thin-film construction (although Miekka is much thicker than Bates). Other than that, their processes are incompatible. Their chemistries are incompatible. Bates discloses a rechargeable battery; Miekka discloses a primary battery. (A25)

The Examiner inconsistently rejects appealed claims 26-28 first under § 102(b), as comprising all of the claimed elements, and then under § 103(a), as not comprising all of the claimed elements. (A59, A64). The Examiner can’t have it both ways. If the limitations of claims 26-28 are fully anticipated by the Bates reference, then the Bates reference does not have a missing limitation which allegedly is provided by Miekka.

For purposes of this argument, it is assumed *arguendo* that § 103 is the applicable basis for analyzing the Examiner’s attempt to combine Bates and Miekka in an effort to prevent issuance of appealed claims 26-28, 32 and 37.

There are many reasons why Miekka does not and can not compensate for the deficiencies of Bates, including, but not necessarily limited to, the following:

1. Miekka provides a primary (non-rechargeable) battery which would not and could not supply long term power to a MEMS and is very large - not small enough to be

integrated with a MEMS.

2. While Miekka involves large scale deposition on a wide traveling sheet, it does not involve microcircuit deposition and does not teach etching or other ways of selectively removing unwanted material.
3. The aqueous electrolyte of Miekka is dangerous, incompatible and would destroy the battery materials of Bates. The two references are not combinable. It is, therefore, complete erroneous when the Examiner argues it to be obvious to "use the specific electrolyte material of Miekka et al. in the thin-film battery of Bates et al." (A24)
4. The active powders of Miekka can not be used in the process of Bates and would not produce the desired electrochemical reaction. (A24) None of the materials of Miekka are suitable for the lithium - ion battery of Bates. The voltages of the two are also incompatible. (A24, A25)
5. Neither reference discloses a tiny battery integratable with and power sufficient for driving a MEMS, and neither discloses microfabrication for batteries comprising removal of unwanted material.

Under § 103 in respect to Bates with Miekka, where, as here, the prior art relied upon does not disclose or even hint, much less suggest the claimed MEMS microbattery and can not be combined, certain case law precedents come into play and control, as hereinafter set forth.

In addressing the question of whether or not appealed claims 26-28, 32 and 37 are obvious or nonobvious under § 103, it is important that several factors be carefully weighed.

First, case law requires that the Examiner engage in a "problem" analysis to determine whether or

not the prior art addresses the same problem or a different problem than that which confronted the inventors prior to making the present invention. Hindsight reconstruction of the prior art based upon confidential access to the present application is not available to establish obviousness.

The problem confronting the present inventors is identified above. The inventors were able to solve that problem, whereas the prior art did not.

More specifically, "the relationship between the problem which the inventor . . . was attempting to solve and the problem to which any prior art reference is directed" is highly relevant. *Stanley Works v. McKinney Manufacturing Co.*, 216 USPQ 298, 304 (Del. D.C. 1981). Thus, in analyzing the prior art under § 103, we must clearly comprehend the problem addressed by the present inventor and such must be compared or contrasted, as the case may be, with the problem addressed by the prior art.

In respect to the applicability of any reference against claims of a pending U.S. patent application, the Examiner's attention is directed to *In re Gibbons*, 100 USPQ 398, where it is stated:

In considering the question of invention, it is *necessary* to determine whether or not the art relied upon contains *adequate directions* for the practice of the invention without resort to the involved application. (Emphasis added.)

One searches in vain to find where "adequate directions" are provided by the prior art relied on sufficient to reach the presently claimed microbattery integrated or integratable with and power sufficient for a MEMS. Since the prior art relied upon is neither intended nor able to achieve what the Applicants have achieved, as set forth in the presently pending claims, it is respectfully submitted that no directions whatever are provided by the references which would

lead to the present invention, as claimed. Accordingly, the references should be accurately construed and withdrawn.

The pertinent primary inquiries in determining obviousness under § 103 are set forth in the Supreme Court's decision in *Graham v. John Deere*, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966). The primary considerations set forth therein require (1) [objective] determination of the scope and content of the prior art; (2) identification as to the differences between the prior art and the claims at issue; and (3) resolution of the level of ordinary skill in the pertinent art.

In respect to the scope of the prior art and the differences standards, the § 103 criteria provided by *In re Winslow*, 151 USPQ 48 (CCPA 1966) is that the prior art must address and provide the inventor's answer to the particular problem confronting an inventor. Here, the references relied upon by the Examiner do not propose, expressly or inferentially or by sound reasoning, the claimed solution to the inventors' aforementioned problem. Consequently, the references fail the *Winslow* § 103 test.

In *Orthopedic Company, Inc. v. United States*, 217 USPQ 193 (Fed. Cir. 1983), the Federal Circuit set forth a useful guide for determining the scope and content of the prior art. *Orthopedic*, at pages 196, 197, also focuses on the "problem" faced by the inventor:

In determining the relevant art . . . one looks at the nature of the *problem* confronting the inventor.

* * * *

. . . would it then be *nonobvious* to this person of ordinary skill in the art to *coordinate these elements in the same manner as the claims* in suit? The difficulty which attaches to all honest attempts to answer this question can be attributed to the *strong temptation to rely on hindsight* while undertaking this evaluation. It is wrong to use the patent in suit [the patent application before the Examiner] as a guide through the maze of prior art references, combining the right references in the right way so as to achieve the result of the claims in suit. *Monday morning quarterbacking is quite improper when resolving the question of nonobviousness. . . .* (Emphasis added.)

Applying the Federal Circuit's analysis in *Orthopedic*, it is clear the claims of the present application are allowable under § 103. Persons ordinarily skilled in the art would be charged only with an understanding of the express teachings of the individual references. These references do not expressly teach or suggest the claimed subject matter. To read into the references the inventors' present solution, necessarily requires hindsight reliance on Applicants' application, contrary to the instructions of *Orthopedic*.

The references relied upon teach away from the present invention. No reference even hints at the Applicants' claimed invention. Hence, the references are not available to defeat the pending claims here, under § 103, giving effect to *Orthopedic*. If the Examiner persists in the § 103 rejection, it is again courteously requested that the locations in the references which propose or suggest Applicants' claimed MEMS sized and power sufficient battery be identified.

The Federal Circuit has also said that "[t]he claimed invention must be considered as a whole, and the question is whether there is *something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination.*" (Emphasis provided). *Lindemann Maschinenfabrik GmbH v. American Hoist and Derrick*, 221 USPQ 481 (Fed. Cir. 1984). The above standard was reiterated in *Fromson v. Advance Offset Plate, Inc.*, 225 USPQ 26 (Fed. Cir. 1985). Clearly, the present invention as set forth in the present claims are not obvious "as a whole" from the references.

The Board of Appeals confirms that hindsight reliance through confidential access to an application being examined, in an attempt to arrive at the claimed invention under 35 U.S.C. § 103, is negated. See *Ex parte Clapp*, 227 USPQ 972, 973 (Bd. of App. 1985), which states:

To support the conclusion that the claimed combination is directed to obvious subject matter, *either the references must expressly or impliedly suggest the claimed combination or the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references.* (Emphasis supplied).

Here, there is no express or implied suggestion in the references that the claimed invention could or should be used to solve the problem facing the present inventors. There is no convincing line of reasoning available in respect to the references by which an artisan would, as a matter of obviousness, have arrived at the present claimed invention absent any suggestion, express or implied, in the reference of the solution fashioned by the present inventors, as set forth in the claims.

Here, the indication of nonobviousness is substantial, under the primary considerations of *Graham*, i.e., the basic irrelevance of the prior art to the claimed combination, failure of others to provide the inventor's solution over a long time both before and after the present invention and the fact that others have not foreseen the inventors' solution even though the prior art teachings have been around for some time. A determination of nonobviousness is compelling.

Nonobviousness follows from *Panduit Corp. v. Dennison Manufacturing Co.*, 1 USPQ 2d 1593, 1605 (Fed. Cir. 1987):

Indeed, that *the elements noted by the court lay about in the prior art available for years to all skilled workers, without, as the court found, suggesting anything like the claimed inventions, is itself evidence of nonobviousness.* (Emphasis provided.)

Where, as here, the prior art is simply incapable of functioning as required by the present claims and achieving what is achieved by the present invention, § 103 rejections cannot be sustained. Here as in *Ex parte Gould*, 231 USPQ 943, 946 (Bd. App. 1986):

... the examiner has *failed* to make out a *prima facie* case that ... [the prior art]

achieved or is capable of achieving . . . [what is achieved by the present invention] we are constrained to reverse the rejections based on . . . [the prior art]. (Emphasis supplied.)

For the Examiner to assign attributes to the references which do not, in fact, exist and to entirely discount the critical language within the claims which is directed to Applicants' MEMS battery does not comply with the *Graham* requirement of [objectively] identifying the differences between the claimed invention and the prior art. Under *In re Wood and Eversole*, 202 USPQ 171, 174 (CCPA 1979), it was necessary:

. . . to more closely approximate the reality of the circumstances surrounding the making of an invention. . . . (Emphasis added.)

A brief examination of "hindsight" law as handed down by the Federal Circuit superimposed upon the facts of this case is presented below.

See, for example, *Union Carbide Corp. v. American Can Co.*, 220 USPQ 584, 591 (Fed. Cir. 1984):

. . . helps us to guard against slipping into hindsight rather than viewing the question as the inventor at the time the patented device was developed." (Emphasis provided.)

The hindsight approach was further criticized in *W. L. Gore & Associates, Inc. v. Garlock, Inc.*, 220 USPQ 303, 312-313 (Fed. Cir. 1983):

To imbue one of ordinary skill in the art with knowledge of the invention in suit, when no prior art reference or references of record convey or suggest that knowledge, is to fall victim to the insidious effect of a hindsight syndrome wherein that which only the inventor taught is used against its teacher. (Emphasis added.)

The Federal Circuit repeated its prohibition against "hindsight" in *Uniroyal, Inc. v. Rudkin-Wiley Corp.*, 5 USPQ 2d 1434, 1438, 1439 (Fed. Cir. 1988), where it was held:

"When prior art references require selective combination by the court to render obvious a subsequent invention, there must be some reason for the

combination other than the hindsight gleaned from the invention itself." Something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination.

* * * *

There is no suggestion in any individual prior art reference of such a combination of location and configuration nor is it suggested by the prior art as a whole. ([I]t is impermissible to use the claims as a frame and the prior art references as a mosaic to piece together a facsimile of the claimed invention).

* * * *

... the district court ... does not show that there is any teaching or suggestion in any of the references, or in the prior art as a whole, that would lead one with ordinary skill in the art to make the combination.

* * * *

In view of the antithetical principles of operation and the absence of any teaching or suggestion to combine these prior art devices, there is no apparent basis for the district court's conclusion that it would have been obvious to one skilled in the art to make the combination. (Emphasis added; citations omitted.)

The *Uniroyal* analysis applies here as well.

Clearly, the present invention is not obvious, based upon the analysis of primary considerations mandated by the U.S. Supreme Court in *Graham* and the prohibition against hindsight.

The rejection under § 103 has a further malady. It fails to give any weight to the fact that the prior art patents teach away from the simplicity, reliability, power requirement, and required size and microfabrication required for the present invention. Here, as in *In re Hedges, et al.*, 228 USPQ 685, 687 (Fed. Cir. 1986):

"The totality of the prior art disclosures leads substantially away from the claimed invention". We agree with ... [Applicant] that the prior art as a whole must be considered. The teachings are to be viewed as they would have been viewed by one of ordinary skill. "It is impermissible within the framework of

section 103 to pick and choose from any one reference only so much of it as will support a given position, to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one of ordinary skill in the art". (Emphasis added; citations omitted.)

For the reasons stated, the § 103 rejections cannot be sustained.

As pointed out in the § 102 arguments above and in the October 2004 Declaration of Rodney M. LaFollette, Ph.D., the Bates technology is limited to an external power source for an integrated circuit. The smallest Bates battery is 60-70 times larger than a MEMS. If simultaneous manufacture of a MEMS and a Bates battery were attempted, the high temperatures required by Bates would destroy the MEMS.

Miekka does not teach a battery integratable with a MEMS, nor does Miekka teach that the Miekka technology can be combined with the teachings of Bates. In fact, the two are neither compatible nor combinable. See the October 2004 Declaration of Rodney M. LaFollette, Ph.D., ¶ 66:

The Examiner erroneously asserts that it would have been obvious to anyone skilled in the art to make use of the specific liquid electrolyte material of Miekka (aqueous potassium hydroxide) and flow path "in the thin-film battery of Bates." This is upsettingly off target. Anyone even modestly skilled in the art of batteries would know that exposure of the electrode materials of Bates to a water, would ruin the Bates cell and render it inactive and perhaps dangerous. Further, the external electrolyte reservoir is only useful for extending the shelf-life of an aqueous battery, and is not needed in the solid-state battery of Bates, which (if properly constructed) is stable for years, even with their electrolyte in the cell.

Under § 103, a problem analysis is mandated under controlling case law. Neither Bates nor Miekka address in any way making a microbattery small enough and with adequate power to

be operatively integrated with a MEMS. Neither reference discloses technology capable of doing so.

**D. THE EXAMINER IMPERMISSIBLY AND REPEATEDLY HAS
MADE HIMSELF A FACT WITNESS IN THE
FACE OF EVIDENCE FROM THREE PH.D.S**

The Examiner in the appealed Office Action (A54) and in the parent and continuing patent application makes a number of erroneous factual assertions and draws unfounded conclusion under both § 102 and § 103 in respect to all references relied on, including Bates and Miekka, which defies the Declarations of Dr. LaFollette here, and those of Dr. LaFollette, Dr. Ryan and Dr. Reisner in other related cases. The Examiner's position is presented in such a way as to be very difficult to understand, but is not evidence and does not constitute a factual or expert basis which defeats Applicants' profound declaration evidence to the contrary.

Some of the Examiner's ill-founded assertions and erroneous conclusions are:

1. Bates "is a microfabricated battery." (A60.)
2. Though not taught by Bates and not available in the industry, the Examiner without support asserts it is anticipated or would be obvious from Bates to conform the size, shape and power capacity of Bates to provide a MEMS with an integratable battery. Further, the Examiner gives no weight to critical claim limitations, such as "for direct size and electronic integration into a micro- electronical mechanical system." . (A61)
3. The Bates "electrodes are etched." (A61, A63).
4. The Bates "electrode layers are conductive. (A62).
5. Although Bates does not teach claimed configurations, "flat cell, spirally wound, bipolar and linear; and waive shaped, odd-shaped, were in a can peg in a block"

batteries are all silently anticipated by Bates. (A62).

6. It is sufficient, without any evidence, to nakedly assert anticipation of patterning by Bates, when Bates does not disclose or use patterning. The Examiner simply states: Bates “is capable of producing a pattern.” (A63).

7. Even though aqueous material is dangerously hostile to the make-up of and would destroy the Bates battery, the Examiner boldly but erroneously asserts “it would be obvious . . . to use the specific liquid [aqueous] electrolyte material . . . in the thin-film battery of Bates.” (A65).

8. Both Bates and Miekka are in the “field . . . of providing . . . thin-film micro-sized batteries,” where neither is capable of a micro-sized battery within the context of integration with a MEMS for sufficient power. (A66).

None of the foregoing positions of the Examiner is consistent with the requirements of § 102 or § 103. Each is clearly erroneous and collectively have resulted in wrongful denial of the valuable patent protection for seven years, to which the Applicant’s are clearly entitled.

**E. THE EXAMINER COMMITTED SEVERAL REVERSIBLE
ERRORS IN RESPECT TO APPLICANTS’ EVIDENCE PERTAINING
TO § 102 AND PRIMARY AND SECONDARY CONSIDERATIONS UNDER § 103**

1. INTRODUCTION

As pointed out in greater detail below, the Examiner, in order to make proper § 102 and § 103 determinations where rebuttal evidence is made of record, is duty bound to: (1) meaningfully consider Applicants’ rebuttal evidence; (2) give appropriate weight to Applicants’ rebuttal evidence; (3) weight Applicants’ rebuttal evidence against the

Examiner's evidence; (4) not weight the Applicants' rebuttal evidence against the Examiner's earlier Office Action conclusions, but to vacate his earlier conclusions and begin anew; (5) not treat his own technical notions as if such were evidence; (6) follow carefully the three step mandated procedure under *Graham* in meritoriously giving weight to Applicants' evidence of primary considerations; and (7) carefully evaluate, and be guided by Applicants' evidence under *Graham* of secondary considerations (such as long felt unsatisfied need, failure of others to provide a solution, and commercial success) under *Graham* since this evidence may be the best indicator of nonobviousness.

The Examiner reversibly erred in failing to discharge any of his evidentiary duties as set forth above, greatly to the prejudice of the Applicants. Certainly, there is little, if any likelihood that the correct § 102 and § 103 evaluations could be obtained when, as here, the Applicants' evidence is so badly mishandled, mismanaged, misevaluated, and non-evaluated.

2. **THE EXAMINER ERRONEOUSLY EQUATES
A QUICK READING OF THE DECLARATIONS
TO MEANINGFULLY CONSIDERING THE TESTIMONY**

The Applicants presented testimony from Dr. LaFollette, who is exceptionally well qualified and presented significant relevant evidence. Cost considerations has reduced the Applicants' capacity to and ability to submit evidence from Dr. LaFollette only. Given cost considerations it is no longer possible to obtain on-going evidence from Dr. Ryan and Dr. Reisner. The evidence pertains to anticipation, primary consideration and secondary consideration. All of Applicants' evidence has been repeatedly set to one side in the parent applications, the other continuing applications and this application, was not considered on its merits, and was not weighed against the evidence provided by the Examiner.

Thus, there is nothing objective to indicate the Examiner at any time weighed at all, much less weighed with care, Applicants' evidence. Rather his §102 and § 103 conclusions did not take into account the merits of Applicants' evidence.

**3. THE APPLICANTS' § 102 AND PRIMARY
CONSIDERATIONS EVIDENCE
IS HIGHLY RELEVANT**

The Applicants' § 102 and their § 103 primary and secondary considerations evidence is highly relevant, persuasive, and uncontroverted. Important aspects thereof are presented above, from which it is clear that very significant and persuasive § 102, primary and secondary considerations evidence is of record.

**4. THE CONCEPT OF A PRIMA
FACIE CASE IN THE USPTO
IS PROCEDURAL, NOT SUBSTANTIVE**

There is great, if not conclusive, doubt here as to whether a prima facie case was ever established by the Examiner. Whether the Examiner met his prima facie case or he did not, it is important to remember that in the USPTO a prima facie case is procedural, not substantive. In *In re Paisecki and Meyer*, 223 USPQ 785 (Fed. Cir. 1984), the Federal Circuit reiterated the burden of proof standard applicable in the USPTO. The *Piasecki* appeal concerned an issue of obviousness, but is equally applicable to both anticipation and obviousness. It set down the burden of proof principles which apply here. Specifically, the *Paisecki* court, at 787-788, places the initial burden on the Examiner.

The concept of [a] *prima facie* . . . [case] is but a procedural mechanism to allocate in a orderly way the burdens of going forward and of persuasion as between the Examiner and the Applicant.

* * * * *

The Supreme Court in *Graham vs. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), focused on the procedural and evidentiary processes As adapted to ex parte procedure, *Graham* is interpreted as continuing to place the “burden” of proof on the Patent Office which requires it to produce the factual basis for its rejection of an application” *In re Warner*, 379 F.2d 1011, 1016, 154 USPQ 173, 177 (CCPA 1967). (Emphasis added.)

Accordingly, the initial § 102 and § 103 prima facie conclusions reached by the Examiner must be factually based and, if a prima facie case is made, it merely procedurally shifts the burden to the Applicants.

**5. THE EXAMINER FAILED TO DISCARD HIS
INITIAL POSITION AND DID NOT BEGIN
ANEW UPON ENTRY OF THE DECLARATIONS**

Once the USPTO has established a prima facie case, that prima facie case is not conclusive. See *In re Smyth*, 90 USPQ 106 (CCPA 1951). It merely shifts the procedural burden of proof to the Appellants. See *In re Sichert*, 196 USPQ 209, 215 (CCPA 1977).

The Applicants persuasively discharged that burden by Declarations. See *Ex parte George*, 230 USPQ 575, 578 (Bd. Pat. App. & Interf. 1986).

Where the Examiner has only personal doubts, misplaced technical notions and assertions, but no evidence or sound reasoning and the Applicants have presented competent evidence showing lack of anticipation and nonobviousness, as here, the Examiner cannot be sustained.

Piasecki, at 778, reaffirms that after the Examiner has established a prima facie case, the burden shifts to the Applicants:

After a prima facie case . . . has been established [by the USPTO], the burden of going forward shifts to the Applicant.

Furthermore, *Piasecki* at 790, explains both that which is required by the USPTO to create a prima facie case and the duty placed upon the Examiner following submission of rebuttal evidence:

... *the holding of [a] prima facie* ... [case], being but a legal inference from previously uncontradicted evidence, *is dissipated* ... *the Examiner must consider all the evidence anew*. The process is as stated in *In re Rinehart*, 531 F.2d 1048, 1052, 189 USPQ 143, 147 (CCPA 1976):

Restated, the Examiner's prima facie case, if there was one, disappeared ("dissipated") and the Examiner was duty bound, in good faith to, evaluate all evidence of record "anew."

The *Piasecki* court elaborates on the "anew" requirement:

An earlier decision should not, as it was here, be considered as set in concrete, and Applicant's rebuttal evidence then be evaluated only on its knockdown ability. Analytical fixation on an earlier decision can tend to provide that decision with an undeservedly broadened umbrella effect.

* * * * *

We find that the majority of the *Board did not evaluate the affidavits and the other rebuttal evidence in accordance with accepted evidentiary procedure* as described in *Rinehart* (Emphasis supplied.)

The requirements of *Piasecki* and *Rinehart* were wholly disobeyed by the Examiner in his haste to reaffirm his erroneous present and parent conclusions of anticipation and obviousness. The Examiner's language confirms that he in this and all related applications (a) simply repeatedly shifted to new and equally or more defective prior art in an attempt to avoid considering Applicants' evidence while roadblocking allowance of clearly patentable claims, and (b) did not start anew to evaluate the evidence objectively. Much of the evidence is powerful independent of the Examiner's assertion of new prior art (time and time again). To the extent he evaluated the rebuttal evidence, he did not do so objectively against his own lack of evidence, but only against erroneous conclusions, which were left in place, based on the new art, as an insurmountable obstruction to patentability. The Examiner, in the parent, stated: "[t]he declarations . . . are not persuasive." More is required.

Failure, as here, to dissipate and start anew is reversible error. Failure, as here, to weight the rebuttal evidence against the other evidence of record (and not against the Examiner's earlier Office Action conclusions) was also reversible error.

**6. THE DECLARATIONS WERE
NOT GIVEN WEIGHT, AND WERE
ERRONEOUSLY MISHANDLED AND DISREGARDED**

Instead of seriously evaluating and giving substantive weight to Applicants' evidence, the Examiner brushed to one side the Declarations. By time-after-time shifting to new art, the Examiner pretended that he did not have to evaluate and give weight to Applicants' evidence. A shallow reading by the Examiner of this important evidence followed by ignoring or attempting to side step the evidence with new art was all that could have taken place. The Examiner failed to gain a basic understanding of the evidence.

Applicants' evidence of a long standing problem and the first solution was repeatedly disregarded and was never given weight. Much of the evidence applies to all successively applied prior art.

The errors of the Examiner were compound. The Applicants' long standing problem evidence is powerful. The Examiner set Applicants' solution to a long term problem to one side and did not substantively give it weight, which is reversible error because of the critical nature of Applicants' evidence.

As stated in *Stratoflex*

It is jurisprudentially inappropriate to disregard any relevant evidence on any issue in any case, patent cases included. (Emphasis added.)

Moreover, given the nexus between the present invention and the problem it solved, the evidence of non- anticipation and nonobviousness here is entitled to "great weight." *Stratoflex, Inc.*

v. Aeroquip Corporation, 218 USPQ 871 (Fed. Cir. 1983). See Also *SolderRemoval Co. v. USITC*, 582 F.2d 628, 637, 199 USPQ 129, 137 (CCPA 1978), and *Simmons*, *supra*, at 746.

Here, as in *Simmons*, at 747:

... the *evidence of secondary considerations* in this case, particularly commercial success, *is extremely strong*, and is *entitled to great weight*. In considering the evidence of obviousness/nonobviousness collectively, we conclude the ... [USPTO's] *decision* that the claimed invention ... would have been obvious under 35 U.S.C. 103 *must fall*. (Emphasis supplied.)

All of the teachings in the Bates reference (A47) were available in 1992 and Miekka (A179) in 1997. Yet, since then, no one skilled in the art, (other than the present inventors), has come up with the present invention, as claimed.

If both desirable and obvious, why was the present invention not provided by those skilled in the art during the above-mentioned interval of time? Because, as stated in *Fromson v. Advance Offset Plate, Inc.*, 225 USPQ 26, 32-33 (Fed. Cir. 1985), the invention is not obvious:

The revolutionary ... *properties* of ... [the invention] are undisputed. It is at best bizarre to assert that the subject matter claimed ... was merely ... an obvious extension of ... [the prior art] technology when none skilled in the art attempted such "extension" *during the seven years* ... (Emphasized.)

**7. THE EXAMINER COMMITTED REVERSIBLE ERROR IN
FUNDAMENTALLY DISREGARDING APPLICANTS' HIGHLY
RELEVANT AND EXTRAORDINARILY COMPETENT
EVIDENCE IN RESPECT TO PRIMARY CONSIDERATIONS**

As pointed out above, the Examiner was largely non-responsive to Applicants' primary considerations evidence.

Thus, the Examiner gave no substantive consideration at all and no meaningful weight to Applicants' primary considerations evidence. This is not only reversible error, standing alone, but directly violates the Manual of Patent Examining Procedure (MPEP).

8. **CASE LAW MANDATES CONSIDERATION
AND WEIGHT BE GIVEN TO THE PRIMARY
CONSIDERATIONS EVIDENCE**

Failure to consider and weigh at all Applicants' evidence of primary considerations was reversible error. Note *Ex parte Ohsaka*, 2 USPQ 2d 1461, 1462 (Bd. App. 1987), which states:

The flaw with his approach is that the examiner has, in practical effect, converted a rebuttable presumption into a conclusive or irrebuttable presumption The examiner incorrectly reverts [leaves in place here] to his initial conclusion finding the declaration evidence *unconvincing* [not worthy of reading here] As stated in *In re Reinhart*, 531 F.2d 1048, 1052, 189 USPQ 143, 147 (CCPA 1976). "When . . . [a] prima facie . . . [case] is established and *evidence is submitted in rebuttal, the decision-maker must start over* An earlier decision should not, as it was here, be considered as set in concrete." Again, as stated in *In re Piasecki*, 745 F.2d 1468, 142, 233 USPQ 785, 788 (Fed. Cir. 1984) "*the examiner must consider all of the evidence anew*." (Emphasis provided.)

Patentability decisions cannot be based on arguments or interpretation by the Examiner out of context and for which there is no factual basis of record. They cannot be based on a nonsubstantive response to significant § 102 and § 103 primary consideration evidence. The requirement for a factual basis is as binding on the USPTO as it is on the Appellants. As stated in *Carl Schench, A.G. v. Nortron Corp.*, 218 USPQ 698, 700 (Fed. Cir. 1983):

. . . arguments and interpretations . . . cannot, however, supplant *the presentation of testimony from qualified witnesses* (Emphasis added.)

The Examiner has hard to understand arguments (albeit extreme and ill-founded ones), but not evidence. The Applicants have extraordinarily credible evidence and provide as sound, binding case law basis founded upon the evidence, demonstrating the existence of a non-anticipated, nonobvious invention.

Thus, if the procedural burden somehow shifted to the Applicants, Applicants have unequivocally met that burden and dissipated the Examiner's prima facie case. The appealed claims

are not anticipated by Bates nor made obvious by Bates and Miekka.

**F. THE EXAMINER MISCONSTRUED THE
LAW OF PRODUCT BY PROCESS CLAIMS**

MPEP § 2173.05(P)I states:

A product-by-process claim, which is a product claim that defines the claimed product in terms of the process by which it is made, is proper. *In re Luck*, 476 F.2d 650, 177 USPQ 523 (CCPA 1973); *In re Pilkington*, 411 F.2d 1345, 162 USPQ 145 (CCPA 1969); *In re Steppan*, 394 F.2d 1013, 156 USPQ 143 (CCPA 1967).

In this regard, the Examiner treated the Applicants' "microfabrication" and like claim recitations as naught, stating:

... the patentability of a product is independent of how it was made. (A169.)

To the contrary, MPEP § 2113 clarifies:

The structure implied by the process steps should be considered when assessing the patentability of product-by-process claims over the prior art, especially where the product can only be defined by the process steps by which the product is made, or where the manufacturing process steps would be expected to impart distinctive structural characteristics to the final product. See, e.g. *In re Garnero*, 412 F.2d 276, 279, 162 USPQ 221, 223 (CCPA 1979) (holding "interbonded by interfusion" to limit structure of the claimed composite and noting that terms such as "welded," "intermixed," "ground in place," "press fitted," and "etched" are capable of construction as structural limitations.)

Here, the Examiner erred because the "microfabrication" and like terms produce structural limitations defining over the prior art and the vehicle by which the claimed invention was made possible. Therefore, the "microfabrication" and like limitations in the appealed claims were entitled to substantial weight and no weight was given by the Examiner.

**G. THE ALLOWABLE SUBJECT MATTER
HERE IS PARALLEL TO THE
ALLOWED CLAIM IN A RELATED APPLICATION**

In the parent application, claim 110 (reproduced below) was allowed and is now claim 1 in

U.S. 6,610,440;

1. A microfabricated battery comprising a pair of microscopic electrodes, a microscopic amount of electrolyte disposed in a microscopic site between the electrodes, the microfabricated battery comprising an area as small as one square micron. (A53)

For essentially the same reasons, the appealed claims comprise patentable subject matter.

**H. THE EXAMINATION OF THIS
AND RELATED APPLICATION
DEMONSTRATES LACK OF OBJECTIVITY**

As a minimum, the examination process in the USPTO must be accomplished competently and without anti-applicant bias. The Applicants have received neither in this and related applications. The following demonstrates the inferior and non-objective examination base, which, to a large extent explains the strange, inappropriate and case law violating § 102 and § 103 migrating positions of the Examiner.

I. THE BASELESS RESTRICTIONS

After issuing a twenty-three way restriction (A167) in the parent application, the present Examiner's position was reversed by his supervisor (A173), confining the restriction to five categories, respectively, the categories respectively comprising 13, 46, 22, 19 and 9 claims. The Examiner erroneously placed claims 89-92 in two of the five groups. (A173) No species election was involved. The five way restriction was by “ *agreement*” between the Examiner and the Applicants. (A172)

The categories of invention *agreement* was short lived. There are three pending continuing applications and a fourth is now U.S. 6,610,440 (A31).

In the present one, Serial No. 09/930,539, the claims of single invention Group II of the

parent [claims 10-43, 51-54, 89-92, 94-97 and 103-109] have been whittled in violation of the “*agreement*” from 53 claims to the 20 appealed claims, using invalid restriction and species requirement, where, contrary to the MPEP, no showing of separate nonobvious patentability between the groups of claims was made. (A 140, A141)

In the other two pending continuing applications [Serial No. 10/317,539 and 10/350-474] the same Examiner has carved down the elected claims to 2 claims and 3 claims, respectively, in violation of the *agreement*, using invalid restriction and species requirements, without evidence of evidence of patentability (nonobviousness).

The earliest parent application was filed March 10, 1998, so the erroneous restriction and species tactics have to date left nearly 100 claims unexamined after almost seven years of lost term and fees and costs in the range of \$150,000 - \$200,000.

The fact that the Examiner relies on Bates as the primary reference in all three presently pending continuing applications and in U.S. 6,610,440, belies the feeble restriction and species requirements.

After going to the time expense and effort to present an abundance of Ph.D. battery evidence to the Examiner, the Examiner has ignored and given no weight to this evidence and has simply discarded one reference after another going to one or more new references after another erroneously contending the prior art battery technology not capable of power compatibility and not small enough can be internally integrated with a MEMS to suitably power the MEMS. None of the prior art ever relied upon is capable of or intended to do so.

More specifically, for claims having essentially the same point of novelty, in the parent, Serial No. 09/037,801 the same Examiner first relied on Hochaday 5,575,712 in view of Hochaday

5,631,099, then Arledge 5,437,941. In the present case, Arledge was dropped and Bates and Miekka were erroneously asserted. In Serial No. 10/317,539, claims 105, 140 and 143 were rejected on Bates and Loper 5,607,601. In a fourth continuing application, Serial No. 09/627,959, now U.S. 6,610,440 (A31), the same Examiner rejected all claims [claims 103-109 and 111-121], except one that was allowed, on Bates combined with Knight U.S. 4,737,422. (A95, A98)

Claims 103-109 and 121 forming a single invention in Serial No. 09/627,959, were moved forward to continuing Serial No. 10/350,474, where they became multiple inventions, in the subjective eyes of the same Examiner, leaving the Applicants with two elected claims (claims 116 and 117) instead of 18 claims. In Serial No. 10/350,474, the Examiner presently relies on Bates under § 102 and Bates and Loper under § 103(a).

The foregoing examination bias, through unjustified restrictions and species elections, is unacceptable and demonstrates that the entire examination process has been infected with a serious lack of objectivity.

The ability to objectively examine the present and related application has been critically compromised by either a lack of basic technical understanding or intentional misconstruction of the prior art, resulting in:

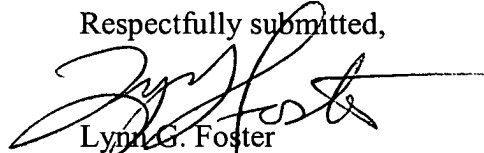
1. The Examiner, functioning as a fact and expert witness, used hindsight and erroneously technical to make his art rejections. (A12, ¶ 24)
2. The Examiner inaccurately asserting that where Bates involves large battery deposition only technology, that may be misconstrued to include etching and patterning by selective removal of unwanted material. None of the Bates material is unwanted. (A17, ¶ 43)

3. The Examiner erroneously contending that the battery reaction of Bates is in the electrolyte, when it is at the electrodes.
4. The Examiner erroneously equating thin-film batteries to tiny area batteries.
5. The Examiner ignoring the size and power limitations of Bates, erroneously contending that a 1cm² Bates battery is integratable with a MEMS and capable of supplying ample power to the MEMS.
6. The Examiner inaccurately contending that the Bates battery cell 10 is integrally formed with semiconductor chip 16, when, the two are formed separately and externally connected by wires 14.
7. The Examiner fails to recognize or ignores the fact that simultaneous formation of the Bates battery and a MEMS (ignoring the size and power compatibility) is impossible as it would heat destroy the MEMS because of the high temperature required to make the Bates battery.
8. The Examiner does not give recognition that Bates requires that all components be “optically transparant.”
9. The Examiner, in error, contending the Bates electrodes are conductive.
10. The Examiner erroneously expands Bates asserting without support that battery configurations, e.g. in a block, were in a can and spirally wound cells are anticipated by Bates, though not disclosed by Bates.

XX. CONCLUSION

For the reasons articulated above, the appealed claims are clearly patentable under § 102 and § 103 and such action by the Board is courteously invited.

Respectfully submitted,



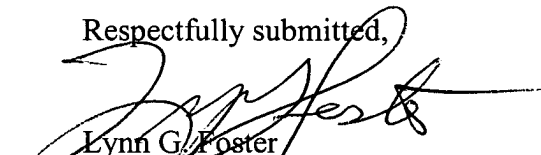
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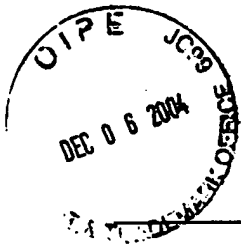
ORAL HEARING

Applicants request an oral hearing before the Board.

Respectfully submitted,



Lynn G. Foster
Attorney for Applicants



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

RODNEY M. LAFOLLETTE, ET AL.

Docket: 7310.C

Serial No.: 09/930,539

Art Unit: 1745

Filed: August 14, 2001

Examiner: RAYMOND ALEJANDRO

For: MICROSCOPIC BATTERIES FOR
MEMS SYSTEMS

APPENDIX ON APPEAL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I hereby certify that this correspondence is being deposited
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an envelope addressed to: Commissioner for Patents, P.O.
Box 1450, Alexandria, VA 22313-1450 on December 2, 2004.

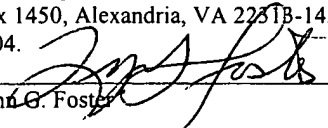

Lynn G. Foster

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21. An energy storage microscopic rechargeable battery having internal only chemical reactants, the battery having a volumetric size comprising a micrometer footprint adapted for direct and congruent size integration with microelectromechanical systems and/or microcircuitry to reduce power losses, the microscopic rechargeable battery comprising etched spaced electrodes of reactant material comprising microscopically sized footprints as low as 0.001 cm^2 with a microscopic space containing electrode reaction accommodating electrolyte interposed between the spaced reactant electrodes.

22. The microscopic rechargeable battery according to claim 21 wherein a microscopic separator associated with the electrolyte is interposed between the microscopic electrodes.

23. The microscopic rechargeable battery according to claim 21 wherein the electrode layers comprise generally flat conductive film.

24. The microscopic rechargeable battery according to claim 21 wherein the microscopic battery is sealed.

25. The microscopic rechargeable battery according to claim 21 wherein the battery geometry is selected from the group consisting of: (a) flat cell; (b) spirally wound; (c) bipolar; and (d) linear.

26. The microscopic rechargeable battery according to claim 21 wherein the battery geometry is selected from the groups consisting of: (a) wire-shaped; (b) odd-shaped; (c) wire in a can; and (d) peg in a block.

27. The microscopic rechargeable battery according to claim 21 wherein at least one electrode comprises a reactant material selected from the group consisting essentially of materials comprising: (a) lead; (b) zinc; (c) nickel; and (d) derivatives thereof [of (a), (b) and (c)].

28. The microscopic rechargeable battery according to claim 21 wherein at least one reactant electrode comprises metal selected from the group consisting essentially of materials comprising: (a) a metal hydride; (b) lithium; (c) silver; and (d) copper, and derivatives thereof.

29. The microscopic rechargeable battery according to claim 21 wherein at least one reactant electrode comprises a material selected from the group consisting essentially of materials comprising: (a) platinum; (b) carbon; (c) cadmium; and (d) lanthanum, and derivatives thereof.

30. The microscopic rechargeable battery according to claim 21 wherein the reaction accommodating electrolyte is selected from the group consisting essentially of: (a) liquid; [and] (b) solid; and (c) a hybrid of liquid and solid.

31. The microscopic rechargeable battery according to claim 21 wherein the reaction accommodating electrolyte is selected from the group consisting essentially of: (a) an ion-conducting polymer; (b) lithium glass; and (c) a polymer containing an ionically-conductive material.

32. The microscopic rechargeable battery according to claim 30 wherein the liquid reaction accommodating electrolyte comprises an aqueous solution also comprised of potassium hydroxide and/or sulfuric acid.

33. An internal electrical energy storage microfabricated rechargeable battery comprising a volumetric microscopic size including a micrometric-sized footprint directly size and electronically integrated into a microelectromechanical system or non-microelectromechanical system microcircuit to alleviate power losses, the battery comprising at least one electrical energy storage cell comprised of reactants in the nature of separated internal microfabricated electrodes each having a footprint within a range of less than 1 cm^2 to 0.0001 cm^2 of reactant material etched and patterned in place to define an internal microfabricated electrolyte storage space between the etched microfabricated electrodes.

34. The microscopic rechargeable battery according to claim 33 wherein at least one reactant electrode comprises a thin film of conductive material.

35. The microscopic rechargeable battery according to claim 33 further comprising a non-conductivity base upon which components of the microscopic battery are carried.

36. The microscopic rechargeable battery according to claim 35 wherein the base is selected from the group consisting essentially of: (a) conformal material and (b) rigid material.

37. The microscopic rechargeable battery according to claim 33 further comprising a non-reactant electrolyte influent flow path extending through at least one electrode by which liquid electrolyte is introduced into the storage space.

38. The microscopic rechargeable battery according to claim 33 wherein the storage space comprises an etched cavity.

39. The microscopic rechargeable battery according to claim 33 wherein a separator associated with electrolyte in the storage space prevents contact between the electrodes.

40. The microscopic rechargeable battery according to claim 33 wherein the storage space comprises a porous separator carrying reaction accommodating electrolyte.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

RODNEY M. LAFOLLETTE, ET AL.

Docket: 7310.C

Serial No.: 09/930,539

Art Unit: 1745

Filed: August 14, 2001

Examiner: RAYMOND ALEJANDRO

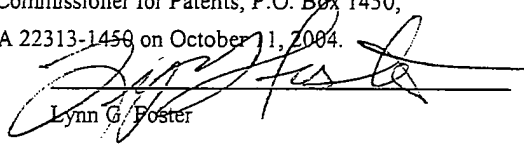
For: MICROSCOPIC BATTERIES FOR
MEMS SYSTEMS

OCTOBER 2004 DECLARATION OF RODNEY M. LAFOLLETTE, Ph.D.

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I hereby certify that this correspondence is being deposited with
the United States Postal Service as first class mail in an envelope
addressed to: Commissioner for Patents, P.O. Box 1450,
Alexandria, VA 22313-1450 on October 1, 2004.

Sir:


Lynn G. Foster

I, Rodney M. LaFollette, declare and state as follows:

BACKGROUND

1. I am a citizen of the United States of America and a resident of the State of Utah.
2. I hold a Doctorate in Chemical Engineering from the Brigham Young University.
3. My education and professional curriculum vitae is attached as Exhibit "A."
4. I have many years of business and educational experience. This includes extensive experience in the electric battery field. I am one of only a few foremost experts in sophisticated extreme miniature battery technology.
5. I am an inventor, either sole or joint, of several inventions comprising the subject matter of U.S. patent applications and issued U.S. patents. I am a co-inventor of the invention of the above-identified patent application.
6. I have worked extensively in research and development pertaining to electric batteries and am thoroughly familiar with various electric battery, capacitor and fuel cell developments.

7. The present invention, compared to prior art, is a major break through and comprises, in respect to the prior art, the only technology by which a battery may be prepared in integration with a MEMS as an internal long term source of electrical power for the MEMS. It is impossible for the prior art relied upon to be small enough to be integrated with a MEMS or other microscopic circuit having an equivalent size as a source of electrical energy.

8. The present invention is orders of magnitude more patentably and commercially significant than the invention of the Bates patent U.S. 5,455,126 ('126), which was allowed on the first action at minimal expense to Bates, unlike the present invention. See Exhibit "E."

THE PATENT PROSECUTION

9. Because of inexplicable prejudice and a technical vacuum demonstrated on the part of the U.S. Patent Office (USPO), six years of prosecution where the USPTO has constantly changed positions in respect to 35 U.S.C. § 112 and on the prior art, I and the assignee company, Bipolar technologies, Inc., which I own, have incurred patent costs between \$100,000.00 and \$200,000.00 in an on going effort to gain valuable patent protection, which is clearly merited. I have personally devoted between \$50,000.00 and \$75,000.00 of my time on patent prosecution. The financial and time burden have placed me and the assignee on the verge of insolvency. I have no idea why this and companion applications have been singled out for such partial and inappropriate treatment of a pioneer invention, which solved a previously unsolved long standing problem pertaining to the inability to provide internal power to MEMS circuits.

10. I am bewildered at the shifting between negative positions by the USPO collectively in the parent application (Serial No. 09/037,801) and in this application (see summaries attached as Exhibits "F" and "G"), some of which are identified below:

- a. A twenty three way restriction was reduced to a five way restriction pursuant to a petition in the parent application, leaving parent Claims 10-43, 51-54, 89-92, 94-97 and 103-109 as elected claims pertaining to a single invention. Exh. "J" and "K."
- b. All of the elected claims of the parent were first rejected under § 103(a) on Hockaday 5,759,712 in view of Hockaday 5,631,099. These references were overcome and determined to be irrelevant only at great expense, effort and delay, resulting in the two Hockaday references being entirely discarded.
- c. Next, the elected claims in the parent application were rejected on Arledge U.S. 5,437,941 under § 103(a). Ignoring several Declaration from Ph.D. experts and an Amendment on October 20, 2000, the USPO repeated the Arledge rejection and made the rejection final and refused further prosecution, forcing the Applicants to file the present continuation application, which is limited to the elected claims only of the parent.
- d. Even a CPA proved futile, as the Arledge rejection was maintained. See Exhibit "I."
- e. Inexplicably, in the present application the USPO inconsistently determined that only claims 21-40 in this application pertained to a single invention and claims 10-20, 41-43, 51-54, 89-92, 94-97 and 103-109, part of the elected invention in the parent, were no longer part of a single invention.
- f. The Arledge reference, which the USPO asserted in the final Office Action in the parent, was discarded in this application in favor of two new references, relied upon for the first time. So \$150,000.00 and six years after filing, we start over, but with few claims. Elected claims 21-31, 33-36 and 38-40 were erroneously rejected

for the first time under § 102(b) on Bates '126 and claims 26-28, 32 and 37 were erroneously rejected for the first time under § 103(a) on Bates '126 in view of Miekka '942.

11. How truly valuable it would have been to the Assignee to have had an objective examination of the parent and this continuation application, as did Bates, a much less significant invention. The prosecutorial history of Bates is attached as Exhibit "E."

APPLICANTS' PROBLEM

12. The long term problem solved by the present invention is well identified in a 1998 newspaper article, copy attached as Exhibit "B," which concerns co-inventor Linton Salmon, Ph.D.. Dr. Salmon is a MEMS expert.

13. The problem addressed is also identified in the present application, the specification of which is identical to U.S. Patent 6,610,440 ('440), copy attached as Exhibit "C." See, for example, Column 1, lines 59-62, Column 2, lines 60-64, Column 5, lines 39-54 and Column 8, lines 65-66 of Exhibit "C."

14. Neither Bates '440 nor Miekka U.S. Patent 6,045,942 ('942) address Applicants' problem nor can their technologies, taken alone or together, provide Applicants' solution, i.e. a microbattery small enough and powerful enough to be integrated with and power a MEMS.

DECLARANT'S UNDERTAKING

15. I have been requested to provide an assessment of the 35 U.S.C. § 112 position of the USPO and of the claimed subject matter of the above-identified application in comparison with Bates '440 and Miekka '942, relied upon by the Examiner in this application, to provide testimony concerning the prior art and to identify the patentable differences between the prior art relied upon and the claimed invention. A copy of the Office Action is attached as Exhibit "D,"

which lacks objectivity and demonstrates a lack of technical mastery of both the prior art and the present invention.

16. I consider my skill in the electric battery field to be above ordinary skill. If the claimed invention is not obvious to me, based upon the applied prior art, it would not be obvious to one of ordinary skill.

17. In the course of functioning as indicated above, I received and reviewed a copy of the above-identified application, as filed.

18. I also received and analyzed a copy of the Exhibit "D" Office Action in the above-identified application mailed August 5, 2004, a copy of Bates '440 and Miekka '942 relied upon by the Examiner in said Office Action, and a copy of the Amendment being filed essentially contemporaneously with this Declaration.

19. I was asked to evaluate the 35 U.S.C. § 112 first paragraph rejection, the 35 U.S.C. § 102(b) and the 35 U.S.C. § 103(a) rejections contained within the Exhibit "D" Office Action.

20. I am familiar with the invention of the above-mentioned application, as originally filed, and the claims as originally filed and as presently constituted, due to the above-mentioned contemporaneous Amendment, because I have studies both. I have also read and studied the two patents relied upon in the said Office Action.

21. In the Office Action mailed August 5, 2004 (Exhibit "D"), the USPO makes the following objections and rejections:

a. The USPO objected as follows:

Claims 23 recites the limitation "the thin electrode layers" in line 2. There is insufficient antecedent basis for this limitation in the claim.

Claim 33 recites the limitation "the etched microfabricated electrodes" in line 8. There is insufficient antecedent basis for this limitation in the claim.

- b. The USPO made the following 35 U.S.C. § 112, second paragraph, rejection:

Claims 21-40 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "internal only etched spaced electrodes" in claim 21 and "of internal reactants only in the nature of separated internal microfabricated electrodes" in claim 33 is unclear and ambiguous, thereby rendering the claims indefinite. Further, the foregoing language is not defined by the claim, and the specification does not provide a standard for ascertaining the requisite degree. It is unclear as to what is particularly meant by the "internal only" limitation and its implication with respect to the final battery structure. Further clarification is required.

- c. The USPO made the following 35 U.S.C. § 102(b) rejection:

Claims 21-33, 33-36 and 38-40 are rejected under 35 U.S.C. § 102(b) as being anticipated by Bates et al. 5,455,126.

- d. The USPO made the following 35 U.S.C. § 103(a) rejection:

Claims 26-28, 32 and 37 are rejected...under 35 U.S.C. § 103(a) as being unpatentable over Bates et al. 5,455,126 as applied to claim 30 above, and further in view of Miekka et al. 6,045,942.

22. In its § 102 (b) rejection, the USPO erroneously contends:

a. The instant claims are directed to a microfabricated battery wherein the disclosed inventive concept is the micro-nature of the battery. [To the contrary, the present invention is directed to a microfabricated (deposition and removal of material) battery, which can satisfy the power requirements of and be integrated with a MEMS as an internal source of electrical power.]

b. Bates et al....is a microfabricated battery.

c. [The Bates] micro-battery provides spaced electrodes containing electrode reaction accommodating electrolyte between the electrodes.

d. [T]he [Bates] electrodes are etched.

e. The USPO wrongfully ignores a key inventive claim limitation that the claimed battery must be integratable with a MEMS:

Examiner's note: as to the limitations: a) "adapted for direct and congruent size integrating with microelectrochemical systems and/or microcircuitry to reduce power losses", or b) "for direct size and electronic integrating into a microelectrochemical system or non-microelectrochemical system microcircuit to alleviate power losses", it is contended that this limitation does not distinguish over prior art because the recitation that an element/feature/member is "adapted to (for)" perform(ing) a function is not a positive limitation but only requires the ability to so perform.

f. The USPO engaged in further hindsight reconstruction:

[T]his [Bates'] batteries (sic) stand for flat cells as well as having the battery fabricated onto the semiconductor chip implies having the battery attached thereto (peg in a block). In addition, battery geometries including: the flat cell, spirally wound, bipolar and linear; and wire-shaped, odd-shaped; wire in a can; peg in a block encompasses a very large number of possible permutations of battery configurations.

[I]t is noted that any of these fabrication techniques is capable of producing a patterned or designed material by eating into the material surface as required by action of etching. [Bates doesn't remove material to create a pattern.]

23. In the § 103(a) rejection, the USPO makes clearly erroneous and hindsight based technical assertions:

a. [I]t would have been obvious to one skilled in the art at the time the invention was made to use the specific liquid electrolyte material and the specific electrolyte influent flow path of Miekka et al. in the thin-film battery of Bates et al. as Miekka et al. teaches that the specific aqueous electrolyte is chosen based on the overall chemistry required by the battery and which cooperatively participates to produce the desired electrochemical reaction.

b. [I]t would have been obvious to one skilled in the art at the time the invention was made to use the specific electrode materials of Miekka et al. in the thin-film battery of Bates et al. as Miekka et al. teaches that it would be readily appreciated

that the active electrode material are such materials or combinations thereof which cooperatively participate to produce the desired electrochemical reaction, wherein the cathode electrode includes a material which acts in the overall system as an oxidizing agent and the anode electrode includes an active material that is easily oxide and thus functions as an available source of electrons, and thus, the claimed electrode materials exhibit the afore-mentioned properties.

c. As to the specific battery geometry, it would have been obvious to one skilled in the art at the time the invention was made to use the specific battery geometry of Miekka et al. in the thin-film battery of Bates et al. as Miekka et al. teaches that the anode to cathode electrode geometry may take one of many forms for ease manufacturing. Thus, Miekka et al. envision varied battery geometry so as to improve manufacturing thereof.

d. It is noted that Bates et al. and Miekka et al. are pertinent to each other as well as to applicant's invention as they both share the same field of endeavor of providing working functional thin-film micro-sized batteries.

24. In reaching the misplaced conclusions and making the technically erroneous assertions contained in the above-mentioned Office Action, the Examiner attempted to make himself a fact and an expert witness, engaged in hindsight reliance based upon access to the above-identified application, drew erroneous technical conclusions and made rejections inconsistent with the clear disclosure in the present specification and teachings of the prior art relied upon. See the detailed testimony provided below.

25. As to the objection, the claims have been amended to cure the lack of antecedence.

26. As to the § 112, second paragraph, rejection:

a. batteries are inherently limited to "internal only chemical reactants", whereas fuel cells move the reactants into and out of the cell.

b. "internal only etched spaced electrodes" are disclosed. There is no external etching. The electrodes are internal of the battery and etching of the electrode

therefore is internal, not external. [To make the examination process more efficient, the Applicants have removed the language of concern.]

THE CLAIMED INVENTION HAS BEEN FOUND PATENTABLE OVER BATES

27. In terms of clear non-anticipated, nonobvious invention, the best starting point is the Claim of U.S. Patent 6,610,440 ('440), found allowable over Bates '126, which is reproduced below:

1. A microfabricated battery comprising a pair of microscopic electrodes, a microscopic amount of electrolyte disposed in a microscopic site between the electrodes, the microfabricated battery comprising an area as small as one square micron.

Thus, the '440 patent is a prior admissible by the USPO that the microfabricated battery of the present invention which for the first time can be made as small as one square micron, so as to be integratable with a MEMS, embraces non-anticipated, nonobvious patentable subject matter, equally applicable to the allowance of the presently pending elected claims of this application.

ANALYSIS OF PRIOR ART

ANALYSIS OF BATES

28. Bates (5,455,126) is not enabling because it admits to a disclosure need for Figures 1, 2A-2D, 3, 4A, 4B and 5, but the 5,455,126 ('126) patent comprises no drawings at all. However, the 5,455,126 Bates Patent is a division of U.S. 5,338,625 ('625), which does include the Figures. For ease of reference, the '625 patent (copy attached as Exhibit "H") is analyzed below as if it were the '126 patent.

29. Bates characterizes his invention as being a "thin-film battery" Column 2, line 46. Bates '625 indicates his battery may be a 1992-sized "microbattery" (Abstract, line 2) or a 1992 "macrobattery" (Column 2, line 34).

30. Bates further characterized his invention as a "lithium microbattery" Column 5, line 26. More specifically at Column 3, lines 2-7, Bates '625 states his invention comprises deposition steps only:

...depositing a pair of current collecting films on a substrate; depositing an amorphous cathode layer on the larger of the two collecting films; depositing an amorphous lithium phosphorous oxynitrate electrolyte layer over the cathode; and depositing a metallic anode layer over the electrolyte. (Emphasized).

31. Thus, four depositing steps and no removal steps are taught by Bates as comprising his thin-film battery invention. Microfabrication requires removal of unwanted material. So Bates does not embrace or encompass microfabrication, making it impossible for any Bates battery to be integratable with a MEMS circuit.

32. In respect to the deposition only (no removal) approach of Bates '625, note Column 3, lines 44-48:

The films may be deposited by fr or dc magnetron sputtering or diode sputtering of vanadium in Aragon, vacuum evaporation or other such film deposition techniques common to the semiconductor electronics industry. (Emphasized).

33. Because of inoperability consideration, Bates provides strict limitations to his invention, i.e. the lithium used for the electrolyte layer must be amorphous not crystalline in order for the level of conductivity to be adequate. Column 4, lines 31-39. Similarly, the cathode must be of amorphous vanadium oxide. Column 3, lines 49-52.

34. In terms of size, the Bates Li-VO_x cell is 8 microns thick and covers an area of 1 square centimeter. Column 3, lines 31-32. The smallest cells made by Bates were 1 cm²; others were larger.

35. In reference to the Figures of Bates '625, a 1992 semiconductor chip 16 is shown as having been previously made and mounted on a package 12 in Figure 1. Thus, the chip 16 and the Bates battery are not simultaneously formed and, therefore, are not integrated. Adjacent to, but not on, the chip 16 is formed a Li-VO_x battery cell 10, having thickness of 8 microns and a 1 square centimeter area. Because battery cell 10 is not formed at the time the chip is formed, but later, cell 10 is not an internal power source, but an external one requiring connection to the chip 16 using external wire leads 14.

36. Bates mandates the formation, by deposition only, of spaced larger and small vanadium current collectors 18 and 20 on a substrate 22. Figure 2a. Sputtering of vanadium in Argon is suggested. Column 3, lines 45-56. Note that Bates does not teach in any way, shape or form removal or patterning of any part of the layers comprising current collectors 18 and 20.

37. Next, by deposition only, a cathode layer 24 of amorphous vanadium oxide is deposited on part of the exposed surface of larger current collector 18. Figure 2b. This is accomplished by sputtering vanadium in Argon +14% O₂. Column 3, lines 51-52. No part of layer 24 is removed and layer 24 is disposed entirely within the perimeter of current collector 18.

38. An electrolyte layer 26 is then superimposed over the VO_x cathode layer so as to extend beyond the perimeter of both layers 18 and 24, so as to be contiguous with the substrate 22, the current collector 18 and the cathode 24. Figure 2c. Electrolyte layer 26 is composed of amorphous oxynitride lithium is created by sputtering Li₃PO₄, lithium orthophosphide, in 20 milliTorr of N₂ and a total gas flow of 14 sccm. Layer 26 is characterized as being an "vitreous electrolyte film." No part of the sputter deposition layer 26 is removed. Column 3, lines 52-57.

39. A fourth layer is created by deposition of lithium. Specifically anode layer 28 is formed by film deposition of a smaller layer of lithium over electrolyte layer 26. No part of layer 28

is removed. Bates mandates that the anode layer 28 be in contact with both the electrolyte layer 26 and the smaller current collector layer 20. Figure 2d. Column 4, lines 3-8.

40. The foregoing is consistent with Claim 1 of Bates '625 as shown below:

1. A thin-film electrochemical cell [10, Figure 1] comprising:
 - a) a substrate [22, Figure 2a];
 - b) a first and a second electrically conductive film [18 and 20, Figure 2a] deposited on the surface of said substrate, said first and second films separated horizontally and said first film larger than said second film;
 - c) a third film [24, Figure 2b] of electrically conductive material deposited over said first film;
 - d) a fourth film [26, Figure 2c] of an electrolyte overlapping said third film to extend upon said first film and to partially extend upon said substrate separating said first and second films, said electrolyte having the composition $\text{Li}_x\text{PO}_y\text{N}_z$ where x has an approximate value of 2.8, $2y=3z$ has an approximate value of 7.8 and z has a value between 0.16 and 0.46; and
 - e) a fifth film [28, Figure 2d] of electronically conductive and chemically active material deposited over the remainder of said substrate separating said first and second films and over substantially all of said second and said fourth films, said fifth films being electrochemically stable in contact with said fourth film.

41. Claim 1 of Bates 5,455,126 is more limiting:

1. An electro-optical device comprising:
 - a) An optically transparent anode of a first electrically conductive material;
 - b) an optically transparent electrochromic material overlaying said anode;
 - c) an optically transparent electrolyte containing nitrogen therein overlaying said electrochromic material; and

d) an optically transparent cathode overlaying said electrolyte.
(Emphasized.)

42. The Bates process does not and can not make microscopic batteries integratable with MEMS because: (1) the resulting Bates battery is too large; (2) Bates teaches his battery is external to the device being powered requiring wire leads 14; (3) the high temperatures required to create the Bates battery would destroy the MEMS circuit, if made simultaneously, making the MEMS useless; and (4) Bates constraints his batteries to lithium and to a deposition (additive only) thin layer approach and does not teach a battery obtained from patterning from use of microfabrication techniques, among other reasons.

43. Bates does not propose etching or any other form of patterning by which unwanted material is selectively removed. Bates simply creates flat unaltered layers through deposition, by sputtering, for example. To misconstrue Bates otherwise invades in a major way the prohibited realm of hindsight reconstruction and suggests an examination bias.

44. A lack of USPTO battery expertise is indicated by reason of the following clearly erroneous statements, among others:

- a. Electrolyte is “reaction accommodating”. (The reactions occur at the electrode material/electrolyte interface, or in the interior of the active material, not in the bulk of the electrolyte. The electrolyte merely serves to conduct lithium ions between electrodes, and prevent physical contact between electrodes.)
- b. The “batteries can be scaled down for microelectronics applications, a size that frequently is many times larger than the semiconductor chip on which

they are used.” (This refers to other lithium battery technologies, i.e. non-rechargeable (primary) lithium button cells sold commercially, to power cameras, watches, and other small electronics. These button cells (~1-2 cm² typically) are many times larger than the semiconductor chip. This is what Bates is referring to, rather than the Bates battery.)

- c. “Bates also discloses the fabricating technique may include rf or dc magnetron sputtering, or diode sputtering or cold pressing or lithographic techniques...[t]hus, it is noted that any of these fabrication techniques is capable of producing a patterned or designed material by eating into the material surface as required by action or etching. Thus, the electrodes are etched.” (This is absolutely absurd.)

45. The Examiner mentions five processes. Rf/dc magnetron sputtering and diode sputtering, are *additive* processes, meaning they are methods of depositing but not removing material. Furthermore, when they are used, they create *global* deposits, which are large in area and not patterned. Microscopic features are not created by Bates because patterning is not taught or used by Bates. Patterning, excluded by Bates, must have a low enough resolution (micrometer range typically) to *selectively* remove unwanted material. Bates only teaches a global additive approach. Bates does not teach the patterning for micro-scale feature size, and does not teach etching at all, and certainly not of micro-scale features. The Examiner is in error to groundlessly read into Bates micro-scale etching. Bates does not disclose any *subtractive* process (one that “eats into material,” using the Examiner’s language).

46. "Cold-pressing," is done on a pellet used to perform the sputtering. It does not refer to the battery at all.

47. "Lithography," is misused by the Examiner. A careful reading of the text in question (Column 2, Lines 12-19) shows that Bates was using the term to define the size of the Bates battery, i.e. "sizes achievable with present lithographic techniques". Bates does not relate lithographic processes to the making of the Bates battery per se. Bates does not disclose use of lithographic processes to make the Bates battery.

48. The Examiner incorrectly states, "It is also disclosed the use of current collectors as part of the electrode structure. *Thus, the electrode layers are conductive.*" The current collectors are on the back of the electrode active material. Current flow must flow through the active material of the electrode, until it reaches the current collector. Thus, the current collector is connected in series (electrically speaking) to the active material. The active material in the cathode is very poorly conductive. If very thick, the battery would cease to operate effectively. Contrary to the express position of the Examiner, the current collectors 18 and 20 do not make the electrode layers conductive. In fact, the active material of the cathode is very poorly conductive.

49. The Examiner further inaccurately asserts that the battery geometries for microfabricated cells of the present invention, are anticipated by Bates. This is absolutely ludicrous. Bates does not disclose nor envision battery microfabrication per se, and certainly not to create "peg in a block," "wire-in-a-can," or spirally wound cells.

50. Bates provides no enablement as to how one of ordinary skill in the battery art could create a microbattery small enough to be integrated with a MEMS, nor does Bates use microfabrication to remove unwanted material. A battery integratable or integrated with a MEMS is not possible using the Bates technology.

51. While the term “microbattery” is used in a number of diverse ways in the literature, in the context of the present application, “microbattery” is used to mean a very tiny battery, made by microfabrication, so small that it is integrated or integratable with a MEMS circuit. The Bates technology can not be used to do this.

52. The Examiner further states that the battery of Bates “can be fabricated directly onto a semiconductor chip, onto the semiconductor die or onto any portion of the chip carrier. Thus thin batteries stand for flat cells as well as having the battery fabricated onto the semiconductor chip implies having the battery integrated.” This statement is not true. The Bates battery is clearly not integrated nor integratable with semiconductor 16.

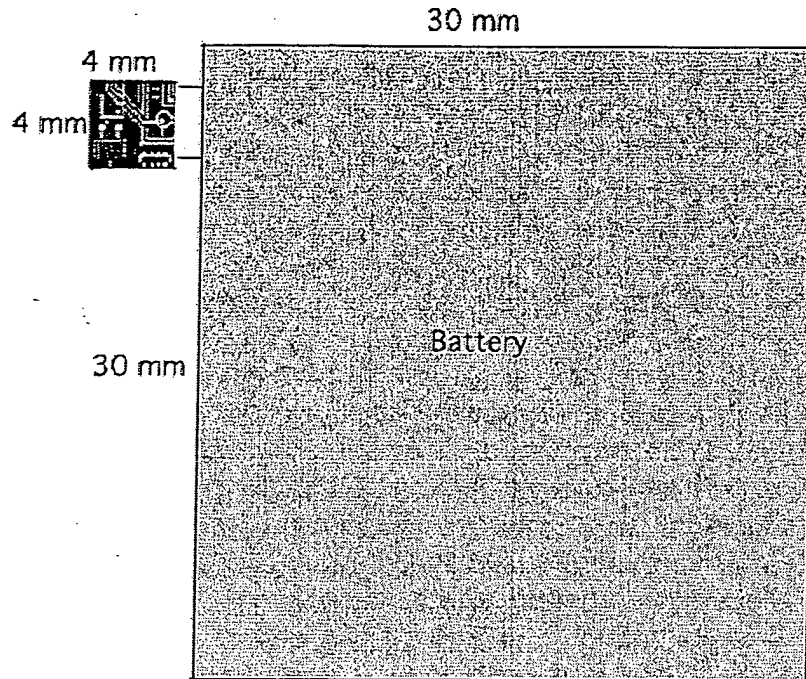
53. There are two primary reasons that the thin-film battery of Bates, and other prior art thin film batteries, cannot be integrated. The first is due to the chemical and thermal conditions necessary to make the batteries.

54. The Bates battery cannot be integrated, as the processing conditions needed for the Bates battery (temperatures $> 400^{\circ}\text{C}$ for extended time) would destroy a microcircuit. The Bates battery must be made separately and used separately as a non-integrated component, that is attached to the circuit with wire leads. As stated by M. Madou, Fundamentals of Microfabrication, 1st Ed., CRC Press, New York, N.Y., p. 442., in reference to the work of Bates,

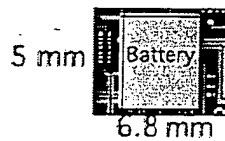
Often the thin film materials deposited in constructing these batteries, such as Li , TiS_2 , V_2O_5 , etc., *prove to be incompatible with the IC process, and the prospect of integrating them with ICs seems remote.* (Italics added). Exh. “L.”

55. The second reason that the battery of Bates as well as other thin-film solid state batteries cannot be integrated, is physical (i.e. the relative sizes of the battery and circuit). The Bates battery could conceivably be used to power a MEMS, as a separate large wire connected power source. However, the size of the battery would make this impractical. Figure “a” below shows the

size of a Bates battery that would be needed for a typical MEMS, while Figure "b" shows the size relationship between a battery according to the present invention and a typical MEMS.



a. Accelerometer Circuit with Thin-Film Bates Battery.



b. Accelerometer Circuit Incorporating our Microscopic Battery.

56. As mentioned above, a review of the claims of Bates reveals the Bates invention to be of narrow scope. It is confined to a thin-film solid state battery not capable of being integrated with a microcircuit. The layers are optically transparent, and the solid electrolyte contains nitrogen atoms. The use of LiPON (lithium phosphorus oxynitride) electrolyte, and vanadium oxide with a fine-grain morphology are part of the Bates invention. In practice, the layers of the present invention are, by comparison to Bates much thicker, and, as such, are not optically transparent.

ANALYSIS OF MIEKKA

57. Miekka (U.S. 6,045,942) does not teach patterning, only deposition (with no partial layer removal via etching or in some other way). The disclosure calls for creation of an ultra thin primary battery, but does not characterize the area nor the volume as being small. A large area would be involved in order to produce the energy levels necessary for operative use and to use the disclosed method.

58. In respect to Figure 2, the ultra thin, low profile battery of Miekka comprises "planar" electrodes and is formed using the following steps:

1. A layer of conductive ink 54 is printed, at station 46, on a thin non-conductive polymeric sheet 38 extending and displaced between rollers 36 and 42;
2. A conductive powder 56 is sprinkled by gravity and vibration, at station 48, on the uncured ink layer 54 and, if necessary, pressing the conductive powder into the uncured ink layer 54 using a roller 64;
3. The ink layer 54 with embedded powder 56 is cured, at station 50;
4. Residual loose conductive powder 56 is removed from the top of the cured ink layer 54, presumably using a vacuum at station 52.

The conductive powder 56 is the active electrode material.

59. Aqueous electrolyte is placed in a porous separator disposed between the cathode and anode in any one of several configurations shown in Figures 1 and 3-6.

60. The ultimate area of the thin battery must be quite large because to displace the non-conductive thin polymer film 38 between rollers 36 and 42 would seem to require film 38 to be of substantial width.

61. The "printing" at station 46 appears to be via an ink roller.

62. The anode is preferably zinc and the cathode preferably copper oxide or silver oxide, while the aqueous electrolyte is preferably potassium hydroxide.

63. Miekka discloses a specific process used to make the Miekka thin-film PRIMARY (non-rechargeable) batteries. That process involves the application of a conductive ink (such as in a printer), and then placement of powdered active materials into the (still-wet) ink. Various cell geometries are disclosed, most with an unequal number of cathodes and anodes (for example, one cathode and two dissimilar anodes, so as to be able to deliver two different voltages, depending on which anode is used). Miekka does not cover any other type of battery fabrication process. Miekka does not disclose microfabrication of a battery, because no unwanted material is removed.

64. The Examiner erroneously states, "Miekka et al discloses that the electrolyte solution may be maintained in a sealed container such as a bag or enclosure." Miekka's external electrolyte reservoir is used in conjunction with a thin-film non-micro fabricated primary battery, not a microfabricated battery. Also disclosed is the use of cupric oxide, silver oxide, nickel oxide and zinc. The Miekka thin-film primary battery is not rechargeable and is not microfabricated.

65. The Examiner states, "Miekka et al. envision an electrolyte influent flow path." This is not news in the battery world. Such a concept is the basis for a whole class of batteries known as "reserve batteries," which has existed for decades. Applicants' disclose the use of an electrolyte influent in conjunction with microfabricated batteries which are integratable with a MEMS.

66. The Examiner erroneously asserts that it would have been obvious to anyone skilled in the art to make use of the specific liquid electrolyte material of Miekka (aqueous potassium hydroxide) and flow path "in the thin-film battery of Bates." This is upsettingly off target. Anyone

even modestly skilled in the art of batteries would know that exposure of the electrode materials of Bates to a water, would ruin the Bates cell and render it inactive and perhaps dangerous. Further, the external electrolyte reservoir is only useful for extending the shelf-life of an aqueous battery, and is not needed in the solid-state battery of Bates, which (if properly constructed) is stable for years, even with their electrolyte in the cell.

67. The Examiner incorrectly states that "it would have been obvious to one skilled in the art at the time the invention was made to use the specific electrode material of Miekka et al. in the thin-film battery of Bates et al. as Miekka et al. teaches that it would be readily appreciated that the active material are such materials or combinations thereof which cooperatively participate to produce the desired electrochemical reaction...." On the contrary, anyone with even mediocre of skill in battery art would know that Miekka is referring to aqueous electrolyte batteries, and that the non-aqueous, non-liquid battery of Bates would be destroyed in the presence of water.

68. Furthermore, the electrode active materials of Miekka would only with difficulty be of any use in the battery of Bates. The powders that Miekka uses as active materials could not be used in the process of Bates. Furthermore, they would not "produce the desired electrochemical reaction," as the materials of Bates are "insertion" compounds, such as LiCoO_2 , LiMn_2O_4 or LiNiO_2 . The reaction mechanism is different than the electrode materials used in aqueous batteries, such as mentioned by Miekka. Normal battery materials, such as used in aqueous batteries (lead-acid, nickel-cadmium, etc.) go through chemical reactions during charge and discharge. In other words, the starting materials are converted to a different compound. For example, lead metal in the negative of a lead-acid battery is converted to a lead sulfate on discharge. In a lithium-ion battery, the electrode materials operate on a different principle. Rather than undergoing a chemical reaction and subsequent phase change, the materials retain their same structure when charged and discharged.

During battery operation, lithium ions are inserted or removed from the crystal lattice of the active materials. None of the materials mentioned by Miekka would be suitable electrode materials in a lithium-ion battery, such as Bates. Also, the operating voltages of Miekka would be much lower than the materials used by Bates.

69. The Examiner erroneously states that the battery of Miekka could be made using the Bates process. This is simply untrue. Miekka discloses a very narrow processing approach, using an ink, etc. Use of an aqueous electrolyte is also disclosed. The process of Bates is utterly incompatible with water. In fact, the battery process is performed in a desiccated environment.

70. The Examiner states, "It is also noted that Bates and Miekka are pertinent to each other as well as to the applicant's invention as they both share the same field of endeavor of providing working functional thin-film micro-sized batteries." Bates and Miekka do not disclose micro-sized integratable MEMS batteries. Furthermore, it is a non-obvious stretch to assert that Bates and Miekka are pertinent to one another. About the only thing that they have in common are thin-film construction (although Miekka is much thicker than Bates). Other than that, their processes are incompatible. Their chemistries are incompatible. Bates discloses a rechargeable battery; Miekka discloses a primary battery.

MIEKKA AND BATES ARE NOT COMPARABLE NOR COMPATIBLE

71. For the reasons presented immediately above, Miekka and Bates are not compatible and not combinable.

CONCLUSION

72. In summary, the presently pending elected claims are not anticipated or made obvious by Bates alone or together with Miekka because Bates does not teach microfabrication, is comparatively huge prohibiting MEMS integration and Bates and Miekka can not be combined, among other reasons.

73. Until the present invention, no one of ordinary or extraordinary skill recognized, over a period of many, many years during which the need existed that a tiny microscopic battery could be microfabricated so as to be size compatible and integratable with a MEMS or similarly sized microcircuit and still have sufficient electrical power to properly drive the MEMS circuit. Thus, the present discovery, including its methodology, is not anticipated nor obvious to those having skill in the battery field. The present invention, for the first time provides a battery fully integratable with a MEMS or MEMS-sized circuit, a feat never heretofore accomplished, which has great technical and commercial significance.

I hereby declare that all statements made herein are of my own knowledge to be true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under § 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize that validity of the application or any patent issued thereon.

DATED this 11 day of October, 2004



RODNEY M. LAFOLLETTE, PH.D.

602 East 300 South
Salt Lake City, Utah 84102
Telephone: (801) 364-5633

10021 October 2004 Declaration of Invention

EXHIBIT "A"

Throughout his career, Dr. Rodney M. LaFollette has worked on high efficiency designs of secondary batteries and fuel cells, especially bipolar designs. Funded research activities over the past ten years include lithium/lithium peroxide solid state batteries, bipolar silver/zinc batteries, several types of bipolar lead acid batteries, including an effort funded by General Motors/Department of Energy to build a bipolar lead acid battery for use in hybrid vehicles. Further funded efforts include microscopic batteries for use in MEMS and other integrated circuits, remote autonomous sensors, fuel cells, and capacitors. Dr. LaFollette also has extensive experience with mathematical modelling of batteries, including the development of a model of spirally-wound lead acid batteries used in the Hybrid Vehicle Program at General Motors. Dr. LaFollette has served as Principal Investigator on research contracts and grants totaling over \$4M over the past 13 years.

Employment

1992 – Present President/Founder, Bipolar Technologies Corp., Provo, UT

1990 – 1992 Vice President of Engineering, Enyon Corp., Provo, UT

1987 – 1990 Senior Materials Eng., International Fuel Cells, South Windsor, CT

Education

Academic Diploma, International School of Brussels, Brussels Belgium, 1975

B.S., M.S., Chemical Engineering, Brigham Young University, 1984

Ph.D., Chemical Engineering, Brigham Young University, 1988

Professional/Honor Societies Areas of Expertise

Tau Beta Pi, Sigma Xi, Mathematical Modeling,

Electrochemical Society, AIChE Electrochemistry, Colloid Chemistry,

Publications

LaFollette, R., Hedman, P., Smith, P., "Analysis of Two-Color Coal Particle Temperature Measurements," *Combustion Science and Technology*, 66, p. 93 (1989).

Ashley, K., Parry, D., Harris, J., Pons, S., Bennion, D., LaFollette, R., Jones, J., King, J., "Properties of Electrochemically Generated Poly(p-Phenylene), *Electrochimica Acta*, 34, No. 5, 599 (1989).

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Stewart, L., Bennion, D., LaFollette, R., "Mathematical Model of the Anodic Oxidation of Lead," *J. Electrochem. Soc.*, 141, No. 9, p. 2416 (1994).

Ryan, D., LaFollette, R.M., Salmon, L., "Microscopic Batteries for Micro ElectroMechanical Systems (MEMS)," *Proceedings of 32nd IECEC*, 97-8, 97136, Honolulu, HI, August (1997).

LaFollette, R.M., Salmon, L.G., Barksdale, R.A., Beachem, B., Harb, J.N., Holladay, J.D., Humble, P.H., Ryan, D.M., "The Performance of Microscopic Batteries Developed for MEMS Applications," *Proceedings of 33rd IECEC*, 98-8, Colorado Springs, CO, August (1998).

Harb, J., LaFollette, R.M., "Predictions of Thermal Behavior of a Spirally-wound Lead-Acid Battery," *Proceedings of 33rd IECEC*, 98-8, Colorado Springs, CO, August (1998).

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Salmon, L.G., Barksdale, R.A., Beachem, B.R., LaFollette, R.M., Harb, J.N., Holladay, J.D.,

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Harb, J., LaFollette, R.M., "Mathematical Model of the Discharge Behavior of a Spirally Wound Lead-Acid Cell," *J. Electrochem. Soc.*, **146**, No. 3, p. 809 (1999).

Ryan, D., LaFollette, R.M., Harb, J.N., "Power Supply Concepts for Remote, Autonomous Sensors," *SAE Proceedings 1999*, Phoenix, AZ, April (1999).

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Singh, P., Rajagopalan, J., LaFollette, R., Fennie Jr., C., Reisner, D.E., "Fuzzy-Logic Charge Controller for Microbatteries," *Proceedings, 28th IEEE Conference* (2001).

LaFollette, R., Singh, P., Broadhead, J., Reisner, D., "Development of a Fuzzy-Logic Managed Microscopic Battery," *IEEE Proceedings, Sensors 2002 Conference*, Orlando, FL, June 12-14, (2002) (Invited Paper).

Patents

1. Bennion D.N.; LaFollette R.M.; Stewart L.L., "Electrochemical System using Bipolar Electrode." U.S. 5,536,598, 25 Aug, 1992.
2. LaFollette R.M., "Bipolar Battery Cells, Batteries and Methods," U.S. 5,536,598, Jul 16, 1996.
3. LaFollette R.M., "Bipolar Battery Cells, Batteries and Methods," U.S. 5,556,627, 17 Sept, 1996.
4. LaFollette R.M., "Methods of making Bipolar Battery Plates comprising Carbon and Fluoroelastomer," U.S. 5,582,622, 10 Dec, 1996.
5. LaFollette, R.M., "Bipolar Battery Cells, Batteries and Methods," U.S. 5,582,937, 10 Dec 1996.
6. LaFollette, R.M., "Source of Electrical Power for an Electric Vehicle and Other Purposes and Related Methods," U.S. 6,063,525, 15 May, 2000.
7. LaFollette, R.M., "Source of Electrical Power for an Electric Vehicle and Other Purposes and Related Methods," U.S. 6,479,179, 25 Aug, 2002.
8. LaFollette, R.M., Salmon, L.G., Harb, J.H., "Microscopic Batteries for MEMS Systems," U.S. 6,610,440B1, 26 August, 2003.

Several Others pending or in submission

EXHIBIT "B"

FRIDAY, JUNE 5, 1998



Mark Philbrick/Brigham Young University

Brigham Young professor Linton Salmon is reflected in a wafer that he helped invent. It contains 1,200 batteries.

Honey, I shrunk the battery

BY DAN NAILEN

THE SALT LAKE TRIBUNE

Computer researchers are not only building better gadgets as technology advances, but making them smaller, faster and cheaper.

Microelectromechanical systems, or MEMS, have dominated the work of many researchers and engineers in recent years. MEMS are a series of miniature electronic structures and sensors integrated on one silicon chip. They range in size from less than one inch to a micron — one-thousandth the thickness of a nickel.

MEMS are not only compact, but usually are more precise than older systems due to the close proximity of their parts. They are already used commercially in automobile air bags, with a tiny MEMS sensor triggering the bag when it senses a rapid change in motion. More potential applications pop up every day.

Now a Brigham Young University engineer wants to give MEMS systems their own power source.

Linton Salmon, BYU's associate dean of engineering and technology, supervised MEMS research for the National Science Foundation in the early 1990s. During his NSF tenure, Salmon noticed dozens of grant seekers developing MEMS. He also noticed most of the projects had to be energized by outside power sources, mainly batteries several times the size of the MEMS chip itself.

"For a lot of electrical engineers, power is just something you buy the battery (for)," Salmon said. "They build a sensor, then go looking for batteries to fit."

When he returned to BYU, Salmon decided to create a microbattery capable of fitting inside MEMS. After several trial runs, he and his colleagues have created a design they believe could revamp MEMS.

Batteries: The Shrinking Power Source

Continued from C-1

Next week, Salmon will present his group's findings to the Solid-State Sensors and Actuator Workshop, a leading MEMS industry forum meeting in Hilton Head, S.C. The conference has been held every other year since 1984 and is limited to 300 researchers, all actively working with MEMS.

Most MEMS industry scientists are either electrical engineers or mechanical engineers, Salmon said, "but batteries are a chemical thing, and we needed chemical engineers" to build a MEMS battery. Salmon's microbattery is made of a nickel and zinc compound, and includes a tiny, tightly sealed reser-

voir of liquid electrolytes to supply the needed power. It is built with the same processes used to make computer chips, he added, including "extremely small dimensions and extremely pure materials."

The entire microbattery is only as thick as a strand of human hair and is the same size as the circuits on the MEMS silicon chips, Salmon said. The design is intended to enable MEMS producers to eventually include the microbattery internally in their products.

"The question," Salmon said, "is how much energy can it put out for how long?"

Salmon sees the microbattery potentially used in conjunction with miniature timers. Since the various sensors on a MEMS chip do not need to be powered up at all times, the timer can send the microbatteries a message to turn on at specific intervals. In turn, the microbatteries would power the sensors to activate and send data, using radio signals, to a remote central computer.

The microbatteries are rechargeable as well, Salmon said, and a MEMS chip could potentially function indefinitely with a small solar cell, timer and one of the new microbatteries.

Some day in the near future, he said, a house thermostat could cost significantly less if it includes a microbattery instead of being wired to a power source and a furnace. A timer-rigged microbattery could power the MEMS sensors measuring the temperature, which would then send the measurements by radio wave to a central computer at assigned intervals.

Once Salmon and other researchers determine how much energy can be stored in a microbattery, the tiny power sources could be used to monitor vital signs in trauma victims or power the pumps regulating insulin flow in diabetics. The batteries could even be used to power sensors that measure automobile tire or engine wear, sending radio messages to the car's onboard computer at

scheduled times.

Robert Huber is a professor of electrical engineering at the University of Utah and a member of the organizing committee for the Hilton Head conference. He said Salmon's research was selected for the conference because "it's high quality work, it's a novel idea and has the possibility of having a lot of uses."

Huber, who has been attending the MEMS conferences since 1986, is quick to note that all the ideas presented at Hilton Head are in the early stages of research. The microbattery and other potential products are still speculative, he said.

"How much energy can you really store?" Huber asked of the microbattery. "That remains to be seen."

Salmon and the BYU research team plan to commercialize their microbattery through Bipolar Technologies, an Orem-based battery manufacturer.

See BATTERIES, Page C-8

EXHIBIT "C"

Office Action Summary

Application No.

09/930,539

Applicant(s)

LAFOLLETTE ET AL.

Examiner

Raymond Alejandro

Art Unit

1745

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 June 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 10-43, 51-54, 89-92, 94-97 and 103-109 is/are pending in the application.
- 4a) Of the above claim(s) 10-20, 41-43, 51-54, 89-92, 94-97 and 103-109 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 21-40 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 November 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>08/14/01</u> . | 6) <input type="checkbox"/> Other: _____ |

Art Unit: 1745

DETAILED ACTION*Election/Restrictions*

1. Applicant's election with traverse of Group I and Species 2 (claims 21-40) in the reply filed on 06/30/04 is acknowledged. The traversal is on the ground(s) that "the restriction and species requirement, in the absence of clear three-pronged proof of distinct, and nonobvious inventions and species" is not adequate. Applicants' also presented arguments addressing the following issues: "the potential harm of restriction and species requirement"; "the controlling statute requires independent and distinct inventions for a proper restriction"; "the examiner have failed to meet their prime facie burden". This is not found persuasive because the particular search for the elected claims of Group 1 (*i.e. the microfabricated battery*) classified in class 429/122 is not required for non-elected claims of Group II (*i.e. methods comprising the acts of fabricating or making microfabricated batteries*) classified in class 29/623.1, that is to say, the search required for *the microfabricated battery per se* is not particularly required for *the methods comprising the acts of fabricating or making microfabricated batteries themselves*. As admitted by the applicants, the inventive concepts involve both the battery product and the method of making the same. In addition, since the restriction requirement has been treated as process of making and product made, it is further noted that the inventions are distinct because the product as claimed can be made by another and materially different process (*as admitted by the applicants*), the battery per se can be made by etching, metallic deposition, layer lithographic patterning and the like. Accordingly, serious burden would be raised if the search of both different inventions was made as required for the separate and distinct inventions.

Art Unit: 1745

2. With respect to the requirement of election of species, it is noted that as admitted by the applicant and disclosed in the specification, the present application contains multiple, several, numerous embodiments represented by the identification of species as delineated in the restriction requirement of 06/04/04. Therefore, the disclosure encompasses different and separated embodiments which are mutually exclusive. Applicant's attention is particularly directed to MPEP 809.02(a) which indicates how to identify species by illustrative figures, examples, mechanical means, particular materials, or other distinguishing characteristics.

Accordingly, serious burden would be raised if the search of such different species was made as required for the separate, distinct and mutually exclusive species.

3. It is also noted that the examiner encouraged the applicants to present reasonable claim groupings and/or election of species in accordance with the claimed subject matter to satisfactorily resolve the restriction and species requirement and because of the large number of claimed battery technologies, environments, systems and embodiments. However, applicants merely decided to traverse the restriction and species requirement without even recognizing that the claimed subject matter is, in fact, intending to cover quite a lot of battery technologies, environment, systems and embodiments from the scale-up (macrobatteries) standpoint.

4. It appears that applicants' position is that micro-battery technology (including microfabricated batteries, micro-fabrication and/or its associated matter) cannot be subjected to restriction and species election requirements because the patentability nature of the subject matter itself (i.e. the micro-scale) only asks for micro-features/systems/elements/members regardless of the specific embodiments, parts, mechanical means, or distinguishing characteristics; and/or invention relationship (e.g. process of making- product made).

Art Unit: 1745

The requirement is still deemed proper and is therefore made *FINAL*.

Priority

5. This application constitutes a continuation of Application No. 09/037801, filed 03/10/98.

Information Disclosure Statement

6. The information disclosure statements (IDS) submitted on 08/14/01 were considered by the examiner.

Drawings

7. The drawings were received on 11/08/02. These drawings are acceptable.

Specification

8. The preliminary amendment filed 08/14/01 does not introduce new matter into the disclosure.
9. The disclosure is objected to because of the following informalities: the current status (i.e. *whether "abandoned; or patented and its patent number"*) of all nonprovisional parent applications referenced should be included. Appropriate correction is required.

Claim Objections

10. Claim 23 recites the limitation "the thin electrode layers" in line 2. There is insufficient antecedent basis for this limitation in the claim.
11. Claim 33 recites the limitation "the etched microfabricated electrodes" in line 8. There is insufficient antecedent basis for this limitation in the claim.

Art Unit: 1745

Claim Rejections - 35 USC § 112

12. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

13. Claims 21-40 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

14. The term "internal only etched spaced electrodes" in claim 21 and "of internal reactants only in the nature of separated internal microfabricated electrodes" in claim 33 is unclear and ambiguous, thereby rendering the claims indefinite. Further, the foregoing language is not defined by the claim, and the specification does not provide a standard for ascertaining the requisite degree. It is unclear as to what is particularly meant by the "internal only" limitation and its implication with respect to the final battery structure. Further clarification is required.

Claim Rejections - 35 USC § 102

15. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

16. Claims 21-31, 33-36 and 38-40 are rejected under 35 U.S.C. 102(b) as being anticipated by Bates et al 5455126.

The instant claims are directed to a microfabricated battery wherein the disclosed inventive concept is the micro-nature of the battery.

Art Unit: 1745

Regarding claims 21 and 33:

Bates et al disclose a thin-film micro-battery, and a method for making same having applications as a primary integrated power source of electronic devices (ABSTRACT/col 2, line 64 to col 3, line 1). *Thus, it is a microfabricated battery.* Bates et al disclose that the thin-film battery comprises a cathode layer, an electrolyte layer and an anode layer (COL 3, lines 2-8). The battery is rechargeable (COL 3, lines 31-35). It is disclosed that the deposition of thin films places the anode close to the cathode. This is because the transport of ions is easier and faster in film layers (COL 2, lines 20-25). *Thus, the micro-battery provides spaced electrodes containing electrode reaction accommodating electrolyte between the electrodes.* Bates et al further disclose that a battery is one of two kinds of electrochemical devices that convert the energy released in chemical reaction directly into electrical energy (col 1, lines 40-43). It is disclosed that micro-cell occupies an area of 1 square centimeter (COL 3, lines 39-42). *Thus, its footprint is less than 20 cm².*

It is disclosed that similarly, a cathode is deposited as a 1 micron thick film over the larger current collector; an electrolyte film is then deposited over the cathode (col 3, lines 60-67); the electrolyte film has a thickness of 1 micron (col 4, lines 5-7); then, a deposition of a film (anode) over the electrolyte film the intervening substrate and the smaller current collector completes the cell (col 4, lines 10-16).

Bates et al reveals that it is configured as a microbattery, the battery can be fabricated directly onto a semiconductor chip, onto the semiconductor die or onto any portion of the chip carrier. The battery is fabricated of solid state materials (ABSTRACT). It is further disclosed that

Art Unit: 1745

the batteries can be scaled down for microelectronics applications, a size that frequently is many times larger than the semiconductor chip on which they are used (col 2, lines 9-11).

Bates et also discloses the fabricating technique may include rf or dc magnetron sputtering, or diode sputtering (COL 3, lines 52-56) or cold pressing (COL 4, lines 3-5) or lithographic techniques (COL 2, lines 17-20). *Thus, it is noted that any of these fabrication techniques is capable of producing a patterned or designed material by eating into the material surface as required by action of etching. Thus, the electrodes are etched.*

Examiner's note: *as to the limitations: a) "adapted for direct and congruent size integrating with microelectromechanical systems and/or microcircuitry to reduce power losses", or b) "for direct size and electronic integrating into a microelectrochemomechanical system or non-microelectrochemomechanical system microcircuit to alleviate power losses", it is contended that this limitation does not distinguish over prior art because the recitation that an element/feature/member is "adapted to (for)" perform(ing) a function is not a positive limitation but only requires the ability to so perform.*

As to claims 22 and 39-40:

Bates et al disclose that the thin-film battery comprises a cathode layer, an electrolyte layer and an anode layer (COL 3, lines 2-8). *Thus, the electrolyte layer acts as the separator associated with the electrolyte interposed between both electrodes.*

Regarding claims 23 and 34:

Bates et al disclose that the thin-film battery comprises a cathode layer, and an anode layer (COL 3, lines 2-8). It is disclosed that the deposition of thin films places the anode close to the cathode. This is because the transport of ions is easier and faster in film layers (COL 2, lines

20-25). It is also disclosed the use of current collectors as part of the electrode structure (COL 3, lines 2-8/COL 3, lines 49-55). *Thus, the electrode layers are conductive.*

With respect to claim 24:

Bates et al disclose lithium-film batteries (COL 1, lines 15-20). *Accordingly, such lithium-based batteries must be sealed so as to prevent the inclusion or aggregation of foreign substances into the cell per se. Thus, the sealed limitation is inherent thereto.*

On the matter of claims 25-26:

Bates et al reveals the formation of thin-film batteries (COL 1, lines 15-20). It is also disclosed that it is configured as a microbattery, and the battery can be fabricated directly onto a semiconductor chip, onto the semiconductor die or onto any portion of the chip carrier. *Thus, thin batteries stand for flat cells as well as having the battery fabricated onto the semiconductor chip implies having the battery attached thereto (peg in a block). In addition, battery geometries including: the flat cell, spirally wound, bipolar and linear; and wire-shaped, odd-shaped; wire in a can; peg in a block encompasses a very large number of possible permutations of battery configurations.*

As far as claims 27-29:

Bates et al discloses that battery may use lead, cadmium (COL 1, lines 57-60); as well as lithium as electrode active materials (COL 3, lines 38-42).

Concerning claims 30-31:

The battery is fabricated of solid state materials (ABSTRACT) or by having a vitreous electrolyte film/layer (COL 4, lines 10-15/ COL 3, lines 2-8). *Thus, the electrolyte is solid.* In addition, Bates et al also disclosed the use of lithium phosphate, phosphosilicate and/or

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phosphorous oxynitride electrolyte films (SEE TABLE 1/ COL 3, lines 2-8). *These are lithium-based vitreous materials.*

As to claims 35-36:

Bates et al further reveals the use of substrate such as glass, alumina, sapphire or various semiconductor or polymer materials (COL 3, lines 2-5/ COL 3, lines 49-55). *Some of these materials exhibit poor conductivity, and are either conformal materials or rigid materials.*

With reference to claim 38:

Bates et also discloses the fabricating technique may include rf or dc magnetron sputtering, or diode sputtering (COL 3, lines 52-56) or cold pressing (COL 4, lines 3-5) or lithographic techniques (COL 2, lines 17-20). *Thus, it is noted that any of these fabrication techniques is capable of producing a patterned or designed material by eating into the material surface as required by action of etching. Thus, the electrodes are etched.*

Therefore, Bates et al anticipates the above-mentioned claims.

Claim Rejections - 35 USC § 103

17. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

18. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any

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evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

19. Claims 26-28, 32 and 37 are rejected and/or further rejected under 35 U.S.C. 103(a) as being unpatentable over Bates et al 5455126 as applied to claim 30 above, and further in view of Miekka et al 6045942

Bates et al are applied, argued and incorporated herein for the reasons above.

In addition, Bates et al disclose the use of acid electrolytes (COL 1, lines 58-62). It is also disclosed that the performance of thin-film batteries is critically limited by the properties of the chosen electrolyte (col 4, lines 33-37).

However, Bates et al does not expressly disclose the specific liquid electrolyte material, the specific electrolyte influent flow path. In addition, Bates et al does not expressly disclose other battery geometries, and electrode materials.

As for claim 26:

Miekka et al disclose that the electrolyte solution may be maintained in a sealed container such as bag or enclosure (COL 6, lines 20-25).

Concerning claims 27-28:

Miekka et al also disclose electrode materials such as cupric oxide, silver oxide, nickel oxide, and zinc (COL 4, lines 1-10).

As to claims 32 and 37:

Art Unit: 1745

Miekka et al discloses a ultra thin battery construction along with a method for making same (ABSTRACT). Miekka et al disclose the addition of appropriate aqueous electrolyte (ABSTRACT) by rupturing the enclosure causing the electrolyte solution to migrate by wicking action (COL 6, lines 23-31). It is also discloses the presence of gap substantially filled with an aqueous solution (COL 2, lines 24-33). *Thus, Miekka et al envision an electrolyte influent flow path.* Miekka et al also disclose that the aqueous electrolyte is chosen based on the overall chemistry required by the battery and may include an aqueous solution of an acid, base or a salt (COL 4, lines 8-11), particularly, the aqueous electrolyte may be either potassium hydroxide (COL 3, lines 59-60).

In view of the above, it would have been obvious to one skilled in the art at the time the invention was made to use the specific liquid electrolyte material and the specific electrolyte influent flow path of Miekka et al in the thin-film battery of Bates et al as Miekka et al teach that the specific aqueous electrolyte is chosen based on the overall chemistry required by the battery and which cooperatively participate to produce the desired electrochemical reaction. In addition, the specific electrolyte influent flow path is required to make the battery operational, and it may be employed with other battery embodiments as will be appreciated by those of skill in the art, including may of the battery embodiments disclosed therein.

As to the specific electrode materials, it would have been obvious to one skilled in the art at the time the invention was made to use the specific electrode materials of Miekka et al in the thin-film battery of Bates et al as Miekka et al teach that it would be readily appreciated that the active electrode material are such materials or combinations thereof which cooperatively participate to produce the desired electrochemical reaction, wherein the cathode electrode

Art Unit: 1745

includes a material which acts in the overall system as an oxidizing agent and the anode electrode includes an active material that is easily oxide an thus functions as an available source of electrons, and thus, the claimed electrode materials exhibit the afore-mentioned properties.

As to the specific battery geometry, it would have been obvious to one skilled in the art at the time the invention was made to use the specific battery geometry of Miekka et al in the thin-film battery of Bates et al as Miekka et al teach that the anode to cathode electrode geometry may take one of many forms for ease manufacturing. Thus, Miekka et al envision varied battery geometry so as to improve manufacturing thereof.

It is also noted that Bates et al and Miekka et al are pertinent to each other as well as to applicant's invention as they both share the same field of endeavor of providing working functional thin-film micro-sized batteries.

Response to Arguments

20. Applicant's arguments with respect to claims 21-40 have been considered but are moot in view of the new ground(s) of rejection. In this regard, it is noted that applicants presented a declaration dated 12/17/02 to address several unresolved issues of and references cited in prior office actions of its related parent application. Accordingly, such declaration has been fully considered.

21. Nevertheless, upon examination of the declaration, the examiner noted that its closing page 19 was not signed. However, applicant submitted an additional page17 containing applicant's signature and thus, an indication that the declaration was fully executed. Applicant is advised that for practical purposes the examiner has accepted the declaration and has no intention

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to discredit it. Nonetheless, for purpose of prosecution and reasons of record, applicant is requested to submit a clarifying statement and/or a substitute declaration obviating such minor informalities. This is done to avoid any confusion which might raise due to the improper matching of specific corresponding page numbers and to further elucidate that applicant did intend to sign the declaration of 12/17/02 containing 19 pages in total, and not a secondary and/or additional declaration/document containing only 17 pages in total. Applicant's cooperation to satisfactorily resolve this issue is requested.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Raymond Alejandro whose telephone number is (571) 272-1282. The examiner can normally be reached on Monday-Thursday (8:00 am - 6:30 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Raymond Alejandro



Application/Control Number: 09/930,539

Page 14

Art Unit: 1745

Examiner
Art Unit 1745

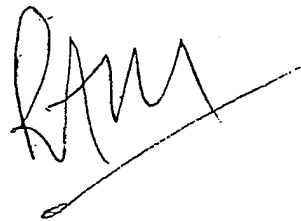
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EXHIBIT "E"

08/248535

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5455126

UTILITY
SERIAL
NUMBER

08/

248935

PATENT

PATENT
NUMBERSERIAL NUMBER
08/248,935FILING DATE
05/25/94
RULE 60CLASS
429

SUBCLASS

GROUP ART UNIT
1102

APPLICANTS JOHN B. BATES, OAK RIDGE, TN; NANCY J. DUDNEY, KNOXVILLE, TN.

CONTINUING DATA***

VERIFIED THIS APPLN IS A DIV OF 07/921,538 07/29/92 PAT

FOREIGN/PCT APPLICATIONS***

VERIFIED

FOREIGN FILING LICENSE GRANTED 06/20/94

Foreign priority claimed 35 USC 119 conditions met	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no	AS FILED	STATE OR COUNTRY	SHEETS DRWGS.	TOTAL CLAIMS	INDEP. CLAIMS	FILING FEE RECEIVED
Verified and Acknowledged	Examiner's initials	→	TN	0	3	1	\$710.00

ADDRESS HAROLD W. ADAMS
ASSOCIATE GENERAL COUNSEL FOR
INTELLECTUAL PROP., LOCKHEED MARTIN
ENERGY SYSTEMS, INC., P.O. BOX 2009
OAK RIDGE, TN 37831-8243

TITLE AN ELECTRA-OPTICAL DEVICE INCLUDING A NITROGEN CONTAINING ELE

U.S. DEPT. OF COMM./PAT.

PARTS OF APPLICATION
FILED SEPARATELY

Applicati

NOTICE OF ALLOWANCE MAILED

CLAIMS A

5/17/95

Bruce F. Bell
Assistant Examiner

Total Claims

3

ISSUE FEE

Amount Due
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Date Paid

6/22/95

KATHRYN GORGOS
PRIMARY EXAMINER
GROUP 1100

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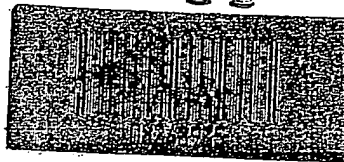
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Patent & Trademark Office is restricted to authorized employees and

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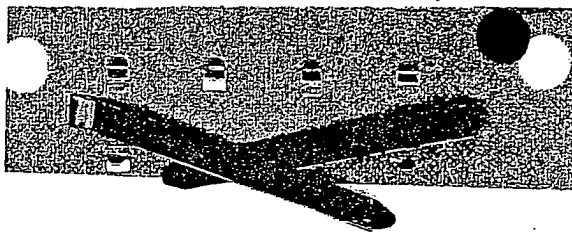
CONTENTS

1. Application _____ papers.
2. *Pre amolita*
3. *11-22 km* *Reg. (3)*
4. *cogn 2/28/95* *Cond B*
5. *3/11* *Interview Summary*
6. *Notice of Allow*
7. *PTO DATE OCT 03 2003*
8. *Petition R-1.48(b)*
9. *Petition granted*
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Class	Sub.	Date	Exmr.
359	265	11/21/94	BFJell
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204	127		
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Updated		3-16-95	BFJell

SEARCH NOTES		
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APS Search	11/21/94	BFJell

INTERFERENCE SEARCHED			
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429	192	3/13/95	BFJell
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PTO UTILITY GRANT
Paper Number 7

*The
United
States
of
America*

The Commissioner of Patents
and Trademarks

*Has received an application for a patent
for a new and useful invention. The title
and description of the invention are en-
closed. The requirements of law have
been complied with, and it has been de-
termined that a patent on the invention
shall be granted under the law.*

Therefore, this

United States Patent

*Grants to the person or persons having
title to this patent the right to exclude
others from making, using or selling the
invention throughout the United States
of America for the term of seventeen
years from the date of this patent, sub-
ject to the payment of maintenance fees
as provided by law.*



Bence Lehman

Commissioner of Patents and Trademarks

Karina J. Cooper

Attest

PTO-1584

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POSITION	ID NO.	DATE
CLASSIFIER	18	6-16-94
EXAMINER	308	6/19/94
TYPIST	21	6/20/94
VERIFIER	211	6/20/94
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SPEC. HAND		
FILE MAINT.		
DRAFTING		

INDEX OF CLAIMS

Claim	Date
Final	
Original	11/18/94
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SYMBOLS
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 - (Through numbers) Canceled
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 I Interference
 A Appeal
 O Objected

FORM PTO-692 (REV. 2-92)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		SERIAL NO. 248935	GROUP/ART UNIT 1102	ATTACHMENT TO PAPER NUMBER 3		
NOTICE OF REFERENCES CITED				APPLICANT(S) Bates et al				
U.S. PATENT DOCUMENTS								
*		DOCUMENT NO.	DATE	NAME	CLASS	SUB- CLASS	FILING DATE IF APPROPRIATE	
	A	5206756	4/27/93	Chestre	359	265		
	B	5142406	8/25/92	Lampert et al	359	275		
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FOREIGN PATENT DOCUMENTS								
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OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, Etc.)								
	R							
	S							
	T							
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EXAMINER <i>Samuel Bell</i>			DATE <i>11/21/94</i>					

* A copy of this reference is not being furnished with this office action.
(See Manual of Patent Examining Procedure, section 707.05 (a).)

#2a
NEALIN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Division patent application of
U.S. Patent Application Serial
07/921,538 filed 29 July 1992:

Docket No.: 957-X-7

Examiner: S. Barts

Art Unit: 1204.

John B. Bates
Nancy J. Dudney

Serial No.:

Filing Date:

Title: THIN FILM BATTERY AND
METHOD FOR MAKING SAME

PRELIMINARY AMENDMENT UNDER 37 C.F.R. 1.115

Honorable Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir:

Submitted herewith is a preliminary amendment under 37 C.F.R. 1.115 requesting
that the specification and claims of the present divisional patent application be amended as
follows:

In the Specification

Delete the title and substitute --An Electro-Optical Device--.

Page 1, before the first sentence of the first paragraph, insert This application is a
division of application Serial No. 07/921,538, filed 29 July 1992, ~~presently pending~~
now U.S. Pat. No. 5,338,625.

In the Claims

Please cancel Claims 1-26 and 30.

16

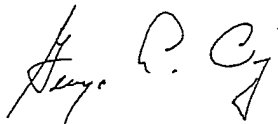
Remarks

In a telephone conversation on 19 May 1993 and a subsequent Office Action dated 28 May 1993, the Examiner issued a restriction to the filed claims of the parent application under 35 U.S.C. 121 as follows: Group I (Claims 1-7) drawn to an electrochemical cell; Group II (Claims 8-12) drawn to a method for making an electrochemical cell; Group III (Claims 13-15) drawn to an electrolyte; Group IV (Claims 16-19) drawn to a method for making an electrolyte; Group V (Claims 20-22) drawn to a cathode; Group VI (Claims 23-26) drawn to a method of making a cathode; and Group VII (Claims 27-29) drawn to an electro-optical device.

Pursuant to the restriction, Applicants elected to first prosecute, without traverse, the Claims of Group I. The Examiner issued a notice of allowance of Claims 1-5 and 30, as amended, of the original Claims 1-7 of Group I in the parent application Serial No. 07/921,538 and Applicants cancelled Claims 6 and 7.

By this Preliminary Amendment to the Divisional Application submitted herewith under 37 C.F.R. 1.60, Applicants cancel Claims 1-26 and 30. Claims now pending in the present Application are Claims 27-29.

Respectfully submitted,



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Telephone No. (615) 576-9676
Facsimile No. (615) 574-0381

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Date of Deposit: May 25, 1994

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Claire M. Chitwood
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Claire M. Chitwood
(Signature of person mailing papers)

A



11X-2/28/95
041-11/28/94

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: John B. Bates
Nancy J. Dudney

Docket No.: 957X-7

Serial No.: 08/248,935

Examiner: B. Bell

Filing Date: 25 May 1994

Art Unit: 1102

Title: AN ELECTRO-OPTICAL DEVICE

AMENDMENT UNDER 37 CFR 1.115

RECEIVED

MAR 9 1995

GROUP 1100

Commissioner of Patents and Trademarks
Box Non-Fee Amendment
Washington, D.C. 20231

Sir:

This amendment is filed on behalf of the Applicants in the above-identified patent application in response to the Examiner's Office Action dated 28 November 1994, and is believed to place this application in condition for allowance.

IN THE SPECIFICATION

At page 8, after line 16, please insert the following

paragraph: --Conventional electro-optical devices known as

"smart windows" are typically formed as a layered structure having a first electrode such as an anode layer, an electrochromic layer, an electrolyte or conductive layer and a second electrode such as a cathode layer, all of which are optically transparent. A limitation of such conventional electro-optical devices is that the electrolyte or conductive layer tends to be unstable and react with the electrodes. Any of

such conventional electro-optical devices may be made choice of conventional materials for the electrodes and electrochromic layers by one skilled in the art and using the novel electrolyte claimed by Applicants for the conventional electrolyte layer. The enhanced stability of Applicants' novel electrolyte arising from the inclusion of nitrogen provides for electro-optical devices having enhanced performance over conventional devices.--

REMARKS

The Examiner rejects Claims 27-29 under 35 USC 112 for failure to provide an enabling description of the claimed invention. The Examiner, however, also states that Claims 27-29 are allowable over the prior art of record and that Claims 27-29 would be allowable if rewritten or amended to overcome the 35 USC 112 rejection.

In a telephone conversation with the Examiner on 28 February 1995, the Examiner concurred that inclusion of the above paragraph in the specification clarified that Applicants' novel electrolyte had utility and novelty both as to electrochemical cells and to electro-optical devices where, in the latter case, all known conventional materials could be chosen by one skilled in the art for the electrode and electrochromic layers and the novel electrolyte of Applicants' claimed invention could be substituted for the conventional electrolyte layer. Therefore, no amendment of Claims 27-29 was deemed necessary and the aforementioned paragraph would be effective to overcome the 35 USC 112 rejection.

The Claims as originally filed are thus deemed distinguishable

over the cited prior art and the application is considered in condition for allowance. Consideration of the present application in view of the foregoing comments is requested, and a favorable action is earnestly solicited.

Respectfully submitted,

George L. Craig
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Patent Counsel
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Oak Ridge, Tennessee 37831-8243
Telephone No. (615) 576-9676
Facsimile No. (615) 574-0381

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I hereby certify that this correspondence is being deposited with the U.S. Postal Service as First-Class Mail in an envelope addressed to Commissioner of Patents and Trademarks, Washington, D.C. 20231, on 28 February, 1995 by *George L. Craig*.

George L. Craig

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ABSTRACT OF THE DISCLOSURE

Described is a thin-film battery, especially a thin-film microbattery, and a method for making same having application as a backup or primary integrated power source for electronic devices. The battery includes a novel electrolyte which is electrochemically stable and does not react with the lithium anode and a novel vanadium oxide cathode. Configured as a microbattery, the battery can be fabricated directly onto a semiconductor chip, onto the semiconductor die or onto any portion of the chip carrier. The battery can be fabricated to any specified size or shape to meet the requirements of a particular application. The battery is fabricated of solid state materials and is capable of operation between -15°C and 150°C .

THIN FILM BATTERY AND METHOD FOR MAKING SAME

This invention was made with Government support under Contract No. DE-AC05-84OR21400 awarded by the U.S. Department of Energy to Martin Marietta Energy Systems, Inc. The Government has certain rights in this invention.

BACKGROUND OF INVENTIONField of Invention

The invention is directed to a thin-film battery and a method for making same. More particularly, the invention is directed to a new thin-film lithium battery having a novel electrolyte permitting a battery to be fabricated having greatly enhanced energy density and specific energy over conventionally available batteries. The invention is also directed to a novel cathode permitting a battery to be fabricated having significantly enhanced energy densities over conventionally available batteries.

Description of Prior Art

A battery is one of two kinds of electrochemical devices that convert the energy released in a chemical reaction directly into electrical energy. In a battery, the reactants are stored close together within the battery itself, whereas in a fuel cell the reactants are stored externally. The attractiveness of batteries as an efficient source of power is that the conversion of chemical energy to electrical energy is potentially 100% efficient although the loss due to internal resistance is a major limiting factor. This potential efficiency is considerably greater than the conversion of thermal energy to mechanical energy as used in internal combustion engines, which always results in heat transfer losses. Moreover, the additional disadvantages of contaminants emitted into the atmosphere as byproducts of incomplete combustion and dwindling availability of fuel supplies have

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intensified research into batteries as an alternative source of energy.

One limitation of conventional batteries is that they use toxic materials such as lead, cadmium, mercury and various acid electrolytes that are facing strict regulation or outright banning as manufacturing materials. Another limitation is that the amount of energy stored and/or delivered by the battery is generally directly related to its size and weight. At one end of the development spectrum, automobile batteries produce large amounts of current but have such low energy densities and specific energies due to their size and weight and such relatively lengthy recharge times that their usage as a source of propulsion is impractical. At the other end of the development spectrum, small, light, lithium batteries used to power small electronic appliances and semiconductor devices have much higher energy densities and specific energies but have not had the capability to be scaled up to provide the high energy for high power applications such as use in automobiles. Further, these small, light, lithium batteries have low charge-discharge cycle capability, limited rechargeability and, even where scaled down for microelectronics applications, size that frequently is many times larger than the semiconductor chip on which they are used.

Thin-film battery technology is foreseen as having several advantages over conventional battery technology in that battery cell components can be prepared as thin, e.g. 1 micron, sheets built up in layers using techniques common to the electronics industry according to the desired application. The area of the sheets can be varied from sizes achievable with present lithographic techniques to a few square meters providing a wide range in battery capacity. Deposition of thin films places the anode close to the cathode resulting in high current density, high cell efficiency and a great reduction in the amount of reactants

used. This is because the transport of ions is easier and faster in thin film layers since the distance the ions must move is lessened.

Most critical to battery performance is the choice of electrolyte. It is known that the principle limitation on rechargeability of prior batteries is failure of the electrolyte. Battery failure after a number of charge-discharge cycles and the loss of charge on standing is caused by reaction between the anode and the electrolyte, e.g. attack of the lithium anode on the lithium electrolyte in lithium batteries. An extra process step of coating the anode with a protective material adds to the complexity, size and cost of the battery.

The power and energy density of a battery is also dependent upon the nature of the cathode. To achieve optimum performance, the open circuit voltage and current density on discharge should be as high as possible, the recharge rate should be high and the battery should be able to withstand many charge-discharge cycles with no degradation of performance. The vanadium oxide cathode of the present invention has a much higher capacity per mole than the crystalline TiS_2 of prior art cathodes.

The present invention avoids the limitations of present battery design and provides a novel battery having application as a battery used with manufacture of semiconductor components and as a high energy, high current macrobattery with appropriate scale-up of the described processes. The present invention includes a novel electrolyte having a good conductivity but more importantly it has electrochemical stability at high cell potentials and requires no protective layer between it and the anode during battery fabrication or use. The present invention also includes a novel cathode having a microstructure providing excellent charge/discharge properties.

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SUMMARY OF THE INVENTION

A primary object of invention is to provide a new thin-film battery and a method for making same.

5 A second object of invention is to provide a new electrolyte for a thin-film battery in which the electrolyte has good ionic conductivity and is not reactive with the battery anode.

Another object of invention is to provide a method for making an improved electrolyte for a thin-film battery.

10 A yet further object of invention is to provide a new cathode having improved microstructure for a thin-film battery and a method for making same.

These and other objects are achieved by depositing a pair of current collecting films on a substrate; depositing
15 an amorphous cathode layer on the larger of the two collecting films; depositing an amorphous lithium phosphorus oxynitride electrolyte layer over the cathode; and depositing a metallic anode layer over the electrolyte.

BRIEF DESCRIPTION OF THE DRAWING

20 Figure 1 is a schematic diagram of a thin-film battery deposited onto a semiconductor chip package with current leads extending to a semiconductor chip.

Figures 2A-2D illustrates the layers in plan view to form a thin-film battery according to the present
25 invention.

Figure 3 schematically illustrates a cross-sectional view of a thin-film battery made according to the present invention.

Figure 4A is a micrograph of a vanadium oxide cathode
30 formed by a sputtering process where the target is aged due to prior sputtering and the process gas flow rate is less than about 15 sccm.

Figure 4B is a micrograph of a vanadium oxide cathode
35 formed by a sputtering process where the target is fresh and the process gas flow rate is greater than about 15 sccm.

Figure 5 illustrates the charge-discharge performance for a microbattery made according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

There are many possible uses for a thin-film, rechargeable battery as a primary or standby power source for low current electronic devices. A thin-film cell could be fabricated directly onto the semiconductor chip, the chip package or the chip carrier and could be fabricated to any specified size or shape to meet the requirements of a particular application. Referring to Figure 1, a possible application is shown in which a thin-film cell 10 is deposited onto a semiconductor chip package 12 with current leads 14 extending to the chip 16. A Li-VO_x cell about 8 microns thick occupying an area of 1 square centimeter as shown has a capacity of 130 microAmp-hours and could supply a current of up to 100 microAmps at a voltage ranging from 3.7 volts at full charge to about 1.5 volts near the end of its discharge. If a larger battery were deposited over the unused area of the package, the capacity and current density of the battery could of course be increased.

With reference to Figures 2A-D, the steps in fabricating such a single cell are shown. Two current collectors, vanadium for example, are deposited as a larger and a smaller 0.5 micron thick film, 18 and 20 respectively, on a substrate 22 such as glass, alumina, sapphire or various semiconductor or polymer materials. The films may be deposited by rf or dc magnetron sputtering or diode sputtering of vanadium in Argon, vacuum evaporation or other such film deposition techniques common to the semiconductor electronics industry. Similarly, an amorphous vanadium-oxide, VO_x, cathode 24 is deposited as a 1 micron thick film over the larger current collector 18 by sputtering vanadium in Argon + 14%O₂. An amorphous oxynitride lithium electrolyte film 26 is then deposited over the cathode 24 by sputtering of Li₃PO₄, lithium

orthophosphate, in 20 milliTorrs of N_2 and a total gas flow of 14 sccm. As before, various film deposition techniques may be used for fabrication of the vitreous electrolyte film 26 although reactive DC sputtering is not available when lithium orthophosphate is the target as it is an insulator material and would accumulate charge until the deposition process stopped. Example targets for the described microbattery measured 25 millimeters in diameter by 3 millimeters thick and were prepared by cold pressing lithium orthophosphate powder followed by sintering of the pressed disc in air at 900°C. Deposition of a 1 micron thick film was carried out over a period of 16-21 hours at an average rate of 8-10 Angstroms per minute. The film 26 has the composition $Li_xPO_yN_z$, where x has the approximate value of 2.8; $2y + 3z$ has the approximate value of 7.8; and z has the approximate value of 0.16 to 0.46. Deposition of a film 28 of lithium over the vitreous electrolyte film 26, the intervening substrate 22 and the smaller current collector 20 completes the cell. A typical film thickness for the lithium film 28 is about 5 microns. Figure 3 is a schematic cross-section view of Figure 2D.

Example performance characteristics of such a battery as described above are an open circuit voltage of 3.6 to 3.8 volts and, for a 1 micron thick cathode, a capacity of about 130 microAmp-hours per square centimeter for a discharge to 1.5 volts. The battery is capable of producing a discharge current of up to 2 milliAmps per square centimeter and can be recharged at a current of at least 20 microAmps per square centimeter. The battery has been subjected to more than 100 charge/discharge cycles with no degradation in performance and, after the first few cycles, the efficiency of the charge/discharge process was approximately 100%. Further, the vitreous oxynitride lithium electrolyte 26 has demonstrated long-term stability in contact with the lithium anode 28 such that the battery does not require the extra protective film, typically

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lithium iodide, to prevent reaction of the lithium anode with the electrolyte.

Performance of thin-film batteries has been critically limited by the properties of the chosen electrolyte. For rechargeable lithium batteries, the electrolyte should have a high lithium ion conductivity and it must be chemically stable in contact with lithium. Films deposited by sputtering or evaporation of inorganic compounds onto substrates held at ambient temperatures are usually amorphous. This is advantageous because, for many lithium compounds, the lithium ion conductivity of the amorphous phase is orders of magnitude higher than that of the crystalline phase and the conductance of the amorphous film is often adequate for use as an electrolyte. As many of these amorphous materials have acceptable low electronic conductivities, there is a wide choice of materials available for possible application in thin-film cells which meet the first two requirements. However, instability in contact with lithium eliminates many materials from consideration and has limited development of a thin-film lithium cell. The amorphous lithium phosphorus oxynitride film 26 of the present invention is made by sputtering Li_3PO_4 in pure N_2 and has both the desired electrical properties and the stability in contact with lithium for fabrication of electrochemical cells.

A comparison of the conductivities at 25°C for several electrolyte compositions in the lithium phosphosilicate system achieved by sputtering lithium silicates and lithium phosphates in Ar and Ar + O_2 is shown in Table 1. The lithium phosphosilicate listed had the highest conductivity of the films in the $\text{Li}_2\text{O}:\text{SiO}_2:\text{P}_2\text{O}_5$ system. Several of the more highly conductive lithium phosphosilicate films with different compositions were investigated as the electrolyte for lithium cells. In each case, the lithium anode 28 reacted with the electrolyte film 26. However, the electrolyte of the present invention was found to be stable

in contact with the lithium anode although it contained only about 2 to 6 at.% nitrogen. Moreover, as shown in Table 1, the conductivity is more than 30 times greater than that of the film deposited by sputtering Li_3PO_4 in 40% O_2 in Argon. Incorporation of nitrogen into the thin films of the present invention increases conductivity at least five times greater than similarly prepared films containing no nitrogen. The increase in conductivity is due to an increase in lithium ion mobility rather than an increase in the number of charge carriers brought about by a change in the structure of the electrolyte. Further, such cells appear to be stable indefinitely, exhibiting only a small voltage loss which is considered to occur due to the electronic conductivity of the electrolyte.

Table 1. Comparison of amorphous lithium phosphate, phosphosilicate, and phosphorus oxynitride electrolyte films.

Target	Process Gas	Film Composition	$\sigma(25^\circ\text{C}) \times 10^8$ (S/cm)	E_g (eV)
Li_3PO_4	40 % O_2 in Ar	$\text{Li}_{1.7}\text{PO}_{1.9}$	7	0.68
$\text{Li}_3\text{PO}_4 + \text{Li}_4\text{SiO}_4$	"	$\text{Li}_{4.4}\text{Si}_{0.23}\text{PO}_{3.2}$	20	0.57
Li_3PO_4	N_2	$\text{Li}_{3.3}\text{PO}_{3.8}\text{N}_{0.22}$	240	0.56

The enhanced conductivity, superior mechanical properties of nitrided glass (e.g. hardness, resistance to fracture) and chemical stability of the oxynitride lithium electrolyte of the present invention could also be used to fabricate enhanced electro-optic devices using electrochromic layers, i.e. so called smart windows, because of the increased resistance to attack from water vapor.

The performance of the lithium microbattery of the present invention is also very dependent on formation of the cathode. Consideration of the microstructure of the cathode is equally as important as consideration of the composition. Typical of prior thin-film batteries is the use cathodes having a characteristic crystalline microstructure. The microstructure is dependent on substrate temperature, extent of the erosion of the target material due to prior sputtering and the pressure and composition of the process gas during deposition. At substrate temperatures of 400°C, vanadium oxide cathodes, for example, consist of crystalline platelets standing on edge while films deposited onto substrates at about 50°C consist of clusters of crystalline fibrous bundles. With reference to Figure 4, two distinct types of microstructure are shown for vanadium oxide films deposited by reactive sputtering of vanadium. When deposited from an eroded target, the cathode films 28 were characterized by a high density of micron-sized fibrous clusters in Figure 4A of crystalline V_2O_5 . When a fresh target surface is used and the flow rate is increased to about 20 sccm, the microstructure of the cathode 28 has the smooth microstructure shown in Figure 4B. The advantage achieved with the amorphous structure over the crystalline structure is that at least three times more lithium ions can be inserted into cathode 28 having such amorphous structure, thus resulting in a lithium cell of much higher capacity.

10

As the sputtering target, e.g. vanadium, ages, the microstructure of the films deposited with higher flow rates gradually evolves to that of the films having fibrous clusters characteristic of deposition at the lower flow rates. This change in the films is evident by a decrease in sputtered target voltage (at constant power) and as much as a 30% decrease in deposition rate.

Lithium cells fabricated with crystalline or amorphous vanadium oxide cathodes had open circuit voltages of 3.6 to 3.7 volts. However, compared with amorphous cathodes, the rates of discharge and charge that the cells with the crystalline cathodes could sustain without excessive polarization are significantly lower, usually less than 3 microAmps per square centimeter. This probably results from poor transport across the interface between the electrolyte 26 and the cathode 28 since the electrolyte 26 does not conformably coat the fibrous clusters of the crystalline cathode 28 but rather covers just the top portion, resulting in a relatively small contact area.

Lithium cells made according to the present invention having the lithium phosphorus oxynitride electrolyte 26 and the smooth amorphous cathode 28 may be discharged at rates of up to 3 milliAmps per square centimeter. With reference to Figure 5, a set of charge-discharge curves for one cycle of such a cell is shown. The total charge passed through this cell between 3.64 volts and 1.5 volts is about 575 milliCoulombs. The capacity of the cell over this voltage

range is 130 microAmp-hours per square centimeter with an energy density of 1.2×10^6 Joules per kilogram based on combined masses of the cathode, electrolyte and anode.

5 The greatly enhanced energy density achievable with thin-film batteries made according to the present invention may, with suitable scaling of process parameters, permit fabrication of high energy thin-film macrobatteries. For example, according to the present teachings, a 25-kWh thin-film lithium battery could be constructed by connecting in
10 series approximately 46 large-area thin-film cells. Such a battery would have an average voltage of 165 volts, a weight of 67 kilograms, a volume of 36 liters, a specific energy of 370 Watt-hours per kilogram and an energy density of 690 Watt-hours per liter.

15 While there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as
20 defined by the appended claims.

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What is claimed is:

1. A thin-film electrochemical cell comprising:
 - a) a substrate;
 - b) a first and a second electrically conductive film deposited on the surface of said substrate, said first and
5 second films separated horizontally and said first film larger than said second film;
 - c) a third film of electrically conductive material deposited over said first film;
 - d) a fourth film of an electrolyte having nitrogen
10 contained therein deposited on and overlapping said third film to extend upon said first film and to partially extend upon said substrate separating said first and second films; and
 - e) a fifth film of electrically conductive material
15 deposited over the remainder of said substrate separating said first and second films and over substantially all of said second and said fourth films.
2. The cell of Claim 1 wherein the substrate material is selected from the group consisting of glass, alumina, semiconductor material and polymer material.
3. The cell of Claim 1 wherein the substrate is selected from the group consisting of a semiconductor chip, a semiconductor package and a semiconductor chip carrier.

c) operating the sputtering apparatus such that the flow rate of the process gas is at least 15 sccm under an operating pressure of about 20 milliTorr; and

10 d) depositing said cathode as an amorphous metal-oxide film at a rate of about 2 nanometers per minute.

24. The method of Claim 23 wherein said amorphous metal oxide film is vanadium oxide.

25. The method of Claim 23 wherein said sputtering apparatus is selected from the group consisting of a reactive dc magnetron sputterer, an rf magnetron sputterer and a diode sputterer.

26. The method of Claim 23 wherein said gas mixture is 14% O₂ in Argon.

27. An electro-optical device comprising:

a) an optically transparent anode of a first electrically conductive material;

5 b) an optically transparent electrochromic material overlaying said anode;

c) an optically transparent electrolyte containing nitrogen therein overlaying said electrochromic material; and

10 d) an optically transparent cathode overlaying said electrolyte.

14.



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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08/248,935 05/25/94 BATES

J 957X7

EXAMINER

D1M1/1128

GEORGE L. CRAIG
MARTIN MARIETTA ENERGY SYSTEMS, INC.
P. O. BOX 2009
OAK RIDGE, TN 37831-8243

ART UNIT PAPER NUMBER

3

1102

DATE MAILED: 11/28/94

This is a communication from the examiner in charge of your application.
COMMISSIONER OF PATENTS AND TRADEMARKS

- ☒ This application has been examined ☐ Responsive to communication filed on _____ ☐ This action is made final.

A shortened statutory period for response to this action is set to expire 3 month(s), 0 days from the date of this letter.
Failure to respond within the period for response will cause the application to become abandoned. 35 U.S.C. 133

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1. ☒ Notice of References Cited by Examiner, PTO-892.
2. ☐ Notice of Draftsman's Patent Drawing Review, PTO-948.
3. ☐ Notice of Art Cited by Applicant, PTO-1449.
4. ☐ Notice of Informal Patent Application, PTO-152.
5. ☐ Information on How to Effect Drawing Changes, PTO-1474.
6. ☐ _____

Part II SUMMARY OF ACTION

1. ☒ Claims 27-29 are pending in the application.
Of the above, claims _____ are withdrawn from consideration.
2. ☐ Claims _____ have been cancelled.
3. ☐ Claims _____ are allowed.
4. ☒ Claims 27-29 are rejected.
5. ☐ Claims _____ are objected to.
6. ☐ Claims _____ are subject to restriction or election requirement.
7. ☐ This application has been filed with Informal drawings under 37 C.F.R. 1.85 which are acceptable for examination purposes.
8. ☐ Formal drawings are required in response to this Office action.
9. ☐ The corrected or substitute drawings have been received on _____. Under 37 C.F.R. 1.84 these drawings are ☐ acceptable; ☐ not acceptable (see explanation or Notice of Draftsman's Patent Drawing Review, PTO-948).
10. ☐ The proposed additional or substitute sheet(s) of drawings, filed on _____, has (have) been ☐ approved by the examiner; ☐ disapproved by the examiner (see explanation).
11. ☐ The proposed drawing correction, filed _____, has been ☐ approved; ☐ disapproved (see explanation).
12. ☐ Acknowledgement is made of the claim for priority under 35 U.S.C. 119. The certified copy has ☐ been received ☐ not been received ☐ been filed in parent application, serial no. _____; filed on _____.
13. ☐ Since this application appears to be in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under Ex parte Quayle, 1935 C.D. 11; 453 O.G. 213.
14. ☐ Other

EXAMINER'S ACTION

Serial Number: 08/248935

-2-

Art Unit: 1102

Drawings

The applicants are requested to supply the drawings as supplied in the parent application S.N. 921538, now U.S. Patent No. 5338625, which are missing from the present divisional application.

Specification

1. The following is a quotation of the first paragraph of 35 U.S.C. § 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

The specification is objected to under 35 U.S.C. § 112, first paragraph, as failing to provide an adequate written description of the invention, as failing to adequately teach how to make and/or use the invention, for failing to present the best mode of carrying out the invention and for failing to provide support for the invention as is claimed.

The specification as written does not disclose what the optically transparent materials are that are used for the anode, cathode, electrochromic layer and the electrolyte layer. The only recitation to an electro-optic device appears at page 8,

Serial Number: 08/248935

-3-

Art Unit: 1102

line 17-24. There has not been found by the examiner anything to suggest that the electrodes and electrochromic layer of the thin layered battery disclosed in the specification are the same materials as those used in the electro optical device and that these materials are in fact optically transparent. There is also no disclosure that the electrolyte of oxynitride lithium is optically transparent, even though the applicants specification disclose that it may be used in an electro-optical device. There is also no discussion of the particular order in which the layers are laid down with respect to the electro-optical device.

Claim Rejections - 35 USC § 112

2. Claims 27-29 are rejected under 35 U.S.C. § 112, first paragraph, for the reasons set forth in the objection to the specification.
3. Claims 27-29 are rejected under 35 U.S.C. § 112, first paragraph, as the disclosure is enabling only for claims limited an anode, an electrolyte, a cathode and an electrochromic layer which may or may not be optically transparent. See M.P.E.P. §§ 706.03(n) and 706.03(z).

Allowable Subject Matter

4. Claim 27 would be allowable if rewritten or amended to overcome the rejection under 35 U.S.C. § 112.

Serial Number: 08/248935

-4-

Art Unit: 1102

5. Claims 28-29 would be allowable if rewritten to overcome the rejection under 35 U.S.C. § 112 and to include all of the limitations of the base claim and any intervening claims.

6. Claims 27-29 are allowable over the prior art of record.

7. The following is an Examiner's statement of reasons for the indication of allowable subject matter: The prior art of record fails to teach the key feature of the applicants instant invention which is an electrolyte containing nitrogen which is used to form the electrochromic device. The addition of nitrogen into the solid electrolyte significantly increases the conductivity. Therefore, even though the construction of the electrochromic device is the same as those of the prior art inventions, the use of an electrolyte utilizing nitrogen to increase the conductivity is not known.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Cheshire (5206756) teaches an electrochromic device which comprises two conductive electrodes separated by a solid electrolyte and an electrochromic material. The device is shown to use optically transparent materials in its construction.

Lampert discloses an electrochromic optical switching device which is layered in the following order: a transparent electrical

Serial Number: 08/248935

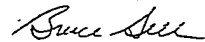
-5-

Art Unit: 1102

conductor, an electrochromic layer, an ionically conductive insulating layer (electrolyte), an organo-sulfur electrode layer, and a transparent conductor layer.

The above prior art however, does not disclose the use of an electrolyte containing nitrogen to increase the conductivity.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bruce Bell whose telephone number is (703) 308-2527.

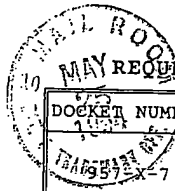


Bruce Bell
Patent Examiner
Art Unit 1102

BFB
November 21, 1994

08/248935

A



REQUEST FOR FILING A PATENT APPLICATION UNDER 37 CFR 1.60

(2-92)

DOCKET NUMBER 1001	ANTICIPATED CLASSIFICATION OF THIS APPLICATION	PRIOR APPLICATION EXAMINER	ART UNIT
	CLASS 29	S. Barts	1204
	SUBCLASS 280		

Address to:

Commissioner of Patents and Trademarks
Washington, D.C. 20231

This is a request for filing a ☐ continuation ☒ divisional application under 37 CFR 1.60, of pending prior application number 07/921,538 filed on July 29, 1992 entitled THIN FILM BATTERY AND METHOD FOR MAKING SAME.

1. Enclosed is a copy of the latest inventor-signed prior application, including a copy of the oath or declaration showing the original signature or an indication it was signed. I hereby verify that the attached papers are a true copy of the latest signed prior application number 07/921,538, and further that all statements made herein of my own knowledge are true; and further that these statements were made with the knowledge that willful false statements and the like are made punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful statements may jeopardize the validity of the application or any patent issuing thereon.

CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
TOTAL CLAIMS		3 - 20 =	0	x \$22.00 =	\$.00
INDEPENDENT CLAIMS		1 - 3 =	0	x \$74.00 =	\$.00
MULTIPLE DEPENDENT CLAIMS (if applicable)				x\$230.00 =	.00
				BASIC FEE	\$ 710.00
				Total of above Calculations =	\$ 710.00
Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28)					
TOTAL					\$ 710.00

2. ☐ A verified statement to establish small entity status under 37 CFR 1.9 and 1.27
☐ is enclosed.
☐ was filed in prior application number ____/____ and such status is still proper and desired (37 CFR 1.28(a)).
3. ☒ The Commissioner is hereby authorized to charge any fees which may be required under 37 CFR 1.16 and 1.17, or credit any overpayment to Deposit Account No. 13-1958. A duplicate of this sheet is enclosed.
4. ☐ A check in the amount of \$ _____ is enclosed.

(2-92)

[Page 1 of 2]

Patent and Trademark Office;
U.S. DEPARTMENT OF COMMERCE



(REQUEST FOR FILING A PATENT APPLICATION UNDER 37 CFR 1.60, PAGE 2)

(2-92)

5. ☒ Cancel in this application original claims 1-26 and 30 of the prior application before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)
6. ☒ Amend the specification by inserting before the first line the sentence:
"This application is a ☐ continuation ☒ division of application number 07/921,538 filed July 29, 1992 (status, abandoned, pending, etc.)."
7. ☐ Transfer the drawings from the pending prior application to this application and abandon said prior application as of the filing date accorded this application. A duplicate copy of this sheet is enclosed for filing in the prior application. (May only be used if signed by person authorized by 37 CFR 1.138 and before payment of issue fee).
8. ☐ New formal drawings are enclosed.
9. ☐ Priority of foreign application number _____, filed on _____ in _____ is claimed under 35 U.S.C. 119.
☐ The certified copy has been filed in prior application number ____/____ and filed _____
10. ☒ A preliminary amendment is enclosed.
11. ☒ The prior application is assigned of record to Martin Marietta Energy Systems, Inc.
12. ☒ Also enclosed:
13. ☒ The power of attorney in the prior application is to: George L. Craig.
 - a. ☒ The Power of attorney appears in the original papers in the prior application.
 - b. ☐ Since the power does not appear in the original papers, a copy of the power in the prior application is enclosed.
 - c. ☒ Address all future correspondence to: (May only be completed by application, or attorney or agent of record.)

George L. Craig, Esq.
Martin Marietta Energy Systems, Inc.
Post Office Box 2009
Oak Ridge, Tennessee 37831-8243
Registration No. 29,293

24 May 1994
Date

George L. Craig
Signature

George L. Craig, Reg. No. 29,293
Typed or printed name

- ☐ Inventor(s)
☐ Assignee of complete interest
☒ Attorney or agent of record
☐ Filed under 37 CFR 1.34(a)
Registration number of acting under 37 CFR 1.34(a) _____

(2-92)

[Page 1 of 2]

Patent and Trademark Office;
U.S. DEPARTMENT OF COMMERCE

PATENT APPLICATION FEE DETERMINATION RECORD

Effective October 1, 1992

Application or Docket Number

248935

CLAIMS AS FILED - PART I

(Column 1)

(Column 2)

SMALL ENTITY OR

OTHER THAN SMALL ENTITY

FOR	NUMBER FILED	NUMBER EXTRA
BASIC FEE		
TOTAL CLAIMS	3	minus 20 = *
INDEPENDENT CLAIMS	1	minus 3 = *
MULTIPLE DEPENDENT CLAIM PRESENT		

RATE	FEE
	\$355.00
x\$11=	
x 37=	
+115=	
TOTAL	

RATE	FEE
	\$710.00
x\$22=	
x 74=	
+230=	
TOTAL	210

* If the difference in column 1 is less than zero, enter "0" in column 2

CLAIMS AS AMENDED - PART II

(Column 1)

(Column 2)

(Column 3)

SMALL ENTITY OR

OTHER THAN SMALL ENTITY

AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	2	20	=
Independent	1	3	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM			

RATE	ADDITIONAL FEE
x\$11=	
x 37=	
+ 115=	
TOTAL	

RATE	ADDITIONAL FEE
x\$22=	
x 74=	
+230=	
TOTAL	

(Column 1) (Column 2) (Column 3)

AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	*	**	=
Independent	*	Same	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM			

RATE	ADDITIONAL FEE
x\$11=	
x 37=	
+ 115=	
TOTAL	

RATE	ADDITIONAL FEE
x\$22=	
x 74=	
+ 230=	
TOTAL	

(Column 1) (Column 2) (Column 3)

AMENDMENT C	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total	*	**	=
Independent	*	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM			

RATE	ADDITIONAL FEE
x\$11=	
x 37=	
+115=	
TOTAL	

RATE	ADDITIONAL FEE
x\$22=	
x 74=	
+230=	
TOTAL	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

FORM PTO-875
(Rev. 10-92)

Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PACE DATA ENTRY CODING SHEET

APPLICATION NUMBER										TYPE		FILING DATE			SPECIAL HANDLING		GROUP ART UNIT		CLASS		SHEETS OF DRAWING	
08/248935										1		05/25/94			2		3204		029		←	
TOTAL CLAIMS		INDEPENDENT CLAIMS		SMALL ENTITY?		FILING FEE		FOREIGN LICENSE		ATTORNEY DOCKET NUMBER												
← 3		← 1		0		- 710		4		95717												

CONTINUITY DATA

[illegible]

PCT/FOREIGN APPLICATION DATA

[illegible]

²
~~28.~~ The electro-optical device of Claim ¹~~27~~ wherein said electrolyte has the composition $\text{Li}_x\text{PO}_3\text{N}_z$ where x has an approximate value of 2.8, $2y + 3z$ has an approximate value of 7.8 and z has a value between 0.16 and 0.46.

³
~~29.~~ The electro-optical device of Claim ¹~~27~~ wherein said cathode is comprised of vanadium oxide having a fine-grain morphology.

30. A macroelectrochemical cell comprising a plurality of series connected electrochemical cells made according to Claim 8.

15

4. The cell of Claim 1 wherein the third conductive material is a metal oxide having an amorphous fine-grain morphology.

5. The cell of Claim 4 wherein the diameter of said grain is less than 1 micron.

6. The cell of Claim 1 wherein said electrolyte is an amorphous lithium phosphorus oxynitride.

7. The cell of Claim 1 wherein the electrolyte has the composition $\text{Li}_x\text{PO}_y\text{N}_z$, where x has an approximate value of 2.8, $2y + 3z$ has an approximate value of 7.8 and z has a value between 0.16 and 0.46.

8. A method for making a thin-film electrochemical cell comprising the steps of:

a) depositing a first and a second horizontally displaced film of electrically conductive material on a substrate surface such that a portion said substrate surface separates said first and second films, said first film larger than said second film;

b) depositing a third film of electrically conductive material on said first film;

c) depositing a fourth film of an electrolyte having nitrogen contained therein on said third film to overlap said third film, the overlap of said fourth film extending

onto said first film and partially onto said portion of said substrate separating said first and second films; and

- 15 d) depositing a fifth film of electrically conductive material over the remainder of said substrate separating said first and second films and over substantially all of said second and said fourth films.

9. The method of Claim 8 wherein said third film of electrically conductive material is an amorphous metal oxide.

10. The method of Claim 8 wherein the electrolyte has the composition $\text{Li}_x\text{PO}_3\text{N}_y$, where x has an approximate value of 2.8, $2y + 3z$ has an approximate value of 7.8 and z has a value between 0.16 and 0.46.

11. The method of Claim 8 wherein all films but said fourth film are deposited by a technique selected from the group consisting of reactive dc magnetron sputtering, rf magnetron sputtering, diode sputtering, and thermal
5 evaporation.

12. The method of Claim 8 wherein the fourth film is deposited by a technique selected from the group consisting of rf magnetron sputtering, diode sputtering, and thermal evaporation.

13. An electrolyte for an electrochemical cell comprising a material having nitrogen contained therein.

14. The electrolyte of Claim 13 wherein said material is lithium phosphorus oxynitride.

15. The electrolyte of Claim 13 comprising the composition $\text{Li}_x\text{PO}_y\text{N}_z$, where x is approximately equal to 2.8, $2y + 3z$ is approximately equal to 7.8 and z has a value between 0.16 and 0.46.

16. A method for making an amorphous electrolyte for an electrochemical cell comprising the steps of:

a) selecting a sputtering apparatus for deposition of thin films;

5 b) selecting a target material for sputtering in said sputtering apparatus;

c) selecting a process gas for operation in said sputtering apparatus;

10 d) operating said sputtering apparatus at a total gas pressure of 20 milliTorr and a total gas flow rate of at least 14 sccm; and

e) depositing said electrolyte at an average rate of 8 Angstroms per minute.

17. The method of Claim 16 wherein said sputtering apparatus is chosen from the group consisting of rf magnetron sputterers and diode sputterers.

18. The method of Claim 16 wherein said sputtering target material is lithium orthophosphate.

19. The method of Claim 16 wherein said process gas is a pure Nitrogen gas.

20. A cathode for a thin-film electrochemical cell comprising an amorphous metal-oxide having a fine-grain morphology.

21. The cathode of Claim 20 wherein the diameter of said grain is less than 1 micron.

22. The cathode of Claim 20 wherein said metal-oxide is VO_x where x is a real number approximately equal to 2.5.

23. A method of making a cathode for a thin-film electrochemical cell comprising the steps of:

a) selecting an unused sputtering target for use in a sputtering apparatus;

b) selecting a process gas mixture for operation in the sputtering apparatus;

5

PATENT APPLICATION SERIAL NO. 08/248935

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

BF11076 06/08/94 08248935 13-1758 110 101 710.00CH 957-X-7

PTO-1556
(5/87)

COMBINED DECLARATION FOR PATENT APPLICATION
AND
POWER OF ATTORNEY

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

THIN FILM BATTERY AND METHOD FOR MAKING SAME

the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith:

Harold W. Adams	Registration No. 19,101
George L. Craig	Registration No. 29,293
Ivan L. Ericson	Registration No. 29,302
J. Donald Griffin	Registration No. 25,730
Herman L. Holsopple	Registration No. 25,632
Joseph A. Marasco	Registration No. 32,798
Preston H. Smirman	Registration No. 35,365
James M. Spicer	Registration No. 26,096

All of: Martin Marietta Energy Systems, Inc.
Post Office Box 2009
Oak Ridge, Tennessee 37831-8243

Direct all correspondence and telephone calls to George L. Craig at (615) 576-9676.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-0

Full name of first inventor: John B. Bates
Inventor's signature: John B. Bates Date: 7/29/92
Residence: Oak Ridge, Tennessee
Citizenship: USA
Post Office Address: 116 Baltimore Drive, Oak Ridge, Tennessee 37830

2-0


Full name of second inventor: Nancy J. Dudnev
Inventor's signature: Nancy J. Dudnev Date: 7/29/92
Residence: Knoxville, Tennessee TN
Citizenship: USA
Post Office Address: 11634 Monticello Road, Knoxville, Tennessee 37922

3-00

Full name of third inventor: Greg R. Gruzalski
Inventor's signature: Greg R. Gruzalski Date: 7/29/92
Residence: Oak Ridge, Tennessee TN
Citizenship: USA
Post Office Address: 118 Monticello Road, Oak Ridge, Tennessee 37830

4-00

Full name of fourth inventor: Christopher F. Luck
Inventor's signature: Christopher F. Luck Date: 7-29-92
Residence: Knoxville, Tennessee TN
Citizenship: USA
Post Office Address: 904 Ponder Road, Knoxville, Tennessee 37923

BAR CODE LABEL 		U.S. PATENT APPLICATION			
SERIAL NUMBER 08/248,935		FILING DATE 05/25/94 RULE 60	CLASS 029	GROUP ART UNIT 3206	
APPLICANT	JOHN B. BATES, OAK RIDGE, TN; NANCY J. DUDNEY, KNOXVILLE, TN; GREG R. GRUZALSKI, OAK RIDGE, TN; CHRISTOPHER F. LUCK, KNOXVILLE, TN.				
	CONTINUING DATA*** VERIFIED THIS APPLN IS A DIV OF 07/921,538 07/29/92 PAT 5,338,625				
	FOREIGN/PCT APPLICATIONS*** VERIFIED				
FOREIGN FILING LICENSE GRANTED 06/20/94					
STATE OR COUNTRY TN	SHEETS DRAWING 0	TOTAL CLAIMS 3	INDEPENDENT CLAIMS 1	FILING FEE RECEIVED \$710.00	ATTORNEY DOCKET NO. 957X7
ADDRESS	GEORGE L. CRAIG MARTIN MARIETTA ENERGY SYSTEMS, INC. P. O. BOX 2009 OAK RIDGE, TN 37831-8243				
TITLE	THIN FILM BATTERY AND METHOD FOR MAKING SAME				
This is to certify that annexed hereto is a true copy from the records of the United States Patent and Trademark Office of the application which is identified above. By authority of the COMMISSIONER OF PATENTS AND TRADEMARKS					
Date		Certifying Officer			

9. ✓
9/1/94

S THIN AND FILM AND BATTERY

321232 THIN

245803 FILM

84166 BATTERY

L1 4697 THIN AND FILM AND BATTERY

=> S THIN WITH FILM WITH BATTERY

321232 THIN

245803 FILM

84166 BATTERY

L2 34 THIN WITH FILM WITH BATTERY

(THIN(1W) FILM(1W) BATTERY)

=> D L2 1-34

(1) 5,342,709, Aug. 30, 1994, Battery utilizing ceramic membranes; Mark S. Yahnke, et al., 429/162, 247 [IMAGE AVAILABLE]

(2) 5,338,625, Aug. 16, 1994, **Thin** **film** **battery** and method for making same; John B. Bates, et al., 429/193, 127 [IMAGE AVAILABLE]

3. 5,215,821, Jun. 1, 1993, Solid-state electrochromic device with proton-conducting polymer electrolyte and Prussian blue counterelectrode; Kuo-Chuan Ho, 428/432; 359/268, 269, 275; 428/688, 689, 697 [IMAGE AVAILABLE]

4. 5,208,121, May 4, 1993, Battery utilizing ceramic membranes; Mark S. Yahnke, et al., 429/162, 247 [IMAGE AVAILABLE]

5. 5,202,201, Apr. 13, 1993, Composite element having a titanium chalcogenide or oxychalcogenide layer, more particularly usable as the positive electrode in a thin film electrochemical cell; Georges Meunier, et al., 429/193; 204/192.15, 192.29; 359/265, 273; 428/689, 698, 701; 429/218 [IMAGE AVAILABLE]

6. 5,114,809, May 19, 1992, All solid-state lithium secondary battery; Yoshifumi Nakacho, et al., 429/192, 218 [IMAGE AVAILABLE]

7. 5,110,696, May 5, 1992, Rechargeable lithiated thin film intercalation electrode battery; Frough K. Shokoohi, et al., 429/218; 29/623.5; 423/594, 599, 641; 427/372.2; 429/224 [IMAGE AVAILABLE]

8. 5,110,694, May 5, 1992, Secondary Li battery incorporating 12-Crown-4 ether; Ganesan Nagasubramanian, et al., 429/192; 252/62.2 [IMAGE AVAILABLE]

9. 5,103,851, Apr. 14, 1992, Solar battery and method of manufacturing the same; Shoji Nishida, et al., 136/249, 258; 437/4, 89 [IMAGE AVAILABLE]

10. 5,100,821, Mar. 31, 1992, Semiconductor AC switch; Gary V. Fay, 437/47; 29/623.5; 429/7 [IMAGE AVAILABLE]

11. 5,030,331, Jul. 9, 1991, Process for preparing iridium oxide film; Yoshiyuki Sato, 205/107; 204/192.15; 205/188, 224; 427/585 [IMAGE AVAILABLE]

12. 5,011,751, Apr. 30, 1991, Electrochemical device; Sachiko Yoneyama,

et al., 429/192, 247 [IMAGE AVAILABLE]

13. 5,006,737, Apr. 9, 1991, Transformerless semiconductor AC switch having internal biasing means; Gary V. Fay, 307/571, 254, 296.1, 296.5, 311 [IMAGE AVAILABLE]

14. 4,977,007, Dec. 11, 1990, Solid electrochemical element and production process therefor; Shigeo Kondo, et al., 428/76; 264/104; 428/209, 323, 375, 408, 480, 516, 522; 429/127, 193, 217 [IMAGE AVAILABLE]

15. 4,936,924, Jun. 26, 1990, **Thin**--**film** solar **battery** and its manufacturing method; Takahiko Inuzuka, 136/249; 437/2, 4 [IMAGE AVAILABLE]

16. 4,892,594, Jan. 9, 1990, Photovoltaic element; Ryoji Fujiwara, et al., 136/258; 257/53, 458, 749 [IMAGE AVAILABLE]

17. 4,876,628, Oct. 24, 1989, Thin film ion conducting coating; Ronald B. Goldner, et al., 361/313; 429/104 [IMAGE AVAILABLE]

18. 4,865,428, Sep. 12, 1989, Electrooptical device; Dennis A. Corrigan, 359/275 [IMAGE AVAILABLE]

19. 4,832,463, May 23, 1989, Thin film ion conducting coating; Ronald B. Goldner, et al., 359/275, 270 [IMAGE AVAILABLE]

20. 4,740,431, Apr. 26, 1988, Integrated solar cell and battery; Roger G. Little, 429/9; 136/244, 291 [IMAGE AVAILABLE]

21. 4,722,877, Feb. 2, 1988, Long cycle life solid-state solid polymer electrolyte cells; Anthony F. Sammells, 429/192, 218 [IMAGE AVAILABLE]

22. 4,689,874, Sep. 1, 1987, Process for fabricating a **thin**--**film** solar **battery**; Masaharu Nishiura, 437/2; 136/244, 258; 437/7, 181, 226 [IMAGE AVAILABLE]

23. 4,672,586, Jun. 9, 1987, Semiconductor memory having circuit effecting refresh on variable cycles; Katsuhiko Shimohigashi, et al., 365/229, 189.09 [IMAGE AVAILABLE]

24. 4,645,726, Feb. 24, 1987, Solid state lithium battery; Masahiko Hiratani, et al., 429/191, 218 [IMAGE AVAILABLE]

25. 4,624,045, Nov. 25, 1986, Method of making thin film device; Shinichiro Ishihara, et al., 437/2; 136/244, 249, 258; 257/53; 437/51, 181 [IMAGE AVAILABLE]

26. 4,572,873, Feb. 25, 1986, Titanium disulfide thin film and process for fabricating the same; Keiichi Kanehori, et al., 428/432; 427/126.1, 255, 255.1; 428/698, 701 [IMAGE AVAILABLE]

27. 4,555,636, Nov. 26, 1985, Pattern detector; Hakubun Fujisawa, et al., 250/208.1; 257/443, 926; 348/294 [IMAGE AVAILABLE]

28. 4,555,456, Nov. 26, 1985, Cathode structure for **thin** **film** **battery**; Keiichi Kanehori, et al., 429/131, 218 [IMAGE AVAILABLE]

29. 4,181,619, Jan. 1, 1980, Antiwear composition; Robert H. Schmitt, et al., 252/32.5, 33, 75, 389.21 [IMAGE AVAILABLE]
30. 3,939,008, Feb. 17, 1976, Use of perovskites and perovskite-related compounds as battery cathodes; John M. Longo, et al., 429/206, 221, 223, 224, 229 [IMAGE AVAILABLE]
31. 3,928,067, Dec. 23, 1975, Polyalkylene glycol ethers in rechargeable lithium nonaqueous batteries; John Broadhead, et al., 429/194, 198, 199, 218 [IMAGE AVAILABLE]
32. 3,864,167, Feb. 4, 1975, Non-aqueous battery using chalcogenide electrode; John Broadhead, et al., 429/194, 199, 218 [IMAGE AVAILABLE]
33. 3,791,867, Feb. 12, 1974, RECHARGABLE NONAQUEOUS BATTERY; John Broadhead, et al., 429/191, 194, 218 [IMAGE AVAILABLE]
34. 3,708,344, Jan. 2, 1973, ORGANIC DEPOLARIZER; Philip Bernstein, 429/201, 213 [IMAGE AVAILABLE]

W

A

P

Paragraph

Thin (W) Film

Film - Thin

Thin Film

Thin (A) Film

Thin Film

```

*
* The APS is available:
*      6:30am - 9:00pm Monday through Friday
*      7:30am - 5:00pm Saturday, Sunday, Holidays
*
* APS is unavailable Thanksgiving Day, Christmas Day,
* and New Year's Day.
*

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FILE 'USPAT' ENTERED AT 11:23:53 ON 20 NOV 94

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*****
*      W E L C O M E   T O   T H E
*      U . S .   P A T E N T   T E X T   F I L E
*****

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=> s oxynitride lithium
    1564 OXYNITRIDE
    68632 LITHIUM
L1      1 OXYNITRIDE LITHIUM
        (OXYNITRIDE(W)LITHIUM)

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=> d 11 1

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1. 5,338,625, Aug. 16, 1994, Thin film battery and method for
making same; John B. Bates, et al., 429/193, 127 [IMAGE
AVAILABLE]

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```

=> s transparent anode
    144274 TRANSPARENT
    58810 ANODE
L2      130 TRANSPARENT ANODE
        (TRANSPARENT(W)ANODE)

```

```

=> s transparent cathode
    144274 TRANSPARENT
    82060 CATHODE
L3      29 TRANSPARENT CATHODE
        (TRANSPARENT(W)CATHODE)

```

```

=> s transparent electrochromic
    144274 TRANSPARENT
    1419 ELECTROCHROMIC
L4      33 TRANSPARENT ELECTROCHROMIC
        (TRANSPARENT(W)ELECTROCHROMIC)

```

```

=> s transparent electrolyte
    144274 TRANSPARENT
    30848 ELECTROLYTE
L5      46 TRANSPARENT ELECTROLYTE
        (TRANSPARENT(W)ELECTROLYTE)

```

```

=> s 12 and 13 and 14 and 15
L6      0 L2 AND L3 AND L4 AND L5

```

```

=> s 12 and 13 and 14

```

L7 0 L2 AND L3 AND L4

=> s 12 and 13 and 15

L8 0 L2 AND L3 AND L5

=> s 12 and 13

L9 7 L2 AND L3

=> d 19 1-7

1. 5,061,569, Oct. 29, 1991, Electroluminescent device with organic electroluminescent medium; Steven A. VanSlyke, et al., 428/457; 252/301.16; 313/504, 506; 428/515, 690, 917 [IMAGE AVAILABLE]

2. 4,950,950, Aug. 21, 1990, Electroluminescent device with silazane-containing luminescent zone; Robert J. Perry, et al., 313/504, 506; 428/690, 917 [IMAGE AVAILABLE]

3. 4,885,211, Dec. 5, 1989, Electroluminescent device with improved cathode; Ching W. Tang, et al., 428/457; 252/301.16; 313/346R, 498, 504, 506, 507; 428/411.1, 461, 515, 917 [IMAGE AVAILABLE]

4. 4,769,292, Sep. 6, 1988, Electroluminescent device with modified thin film luminescent zone; Ching W. Tang, et al., 428/690; 313/504; 428/917 [IMAGE AVAILABLE]

5. 4,720,432, Jan. 19, 1988, Electroluminescent device with organic luminescent medium; Steven A. VanSlyke, et al., 428/457; 252/301.16; 257/40, 103; 313/498, 504, 506, 509; 428/411.1, 461, 515, 917 [IMAGE AVAILABLE]

6. 4,360,763, Nov. 23, 1982, Method and device for control of great currents particularly of the pulse type; Michal Gryzinski, 315/111.01; 200/144B; 313/231.01; 315/344 [IMAGE AVAILABLE]

7. 4,045,677, Aug. 30, 1977, Intense ion beam generator; Stanley Humphries, Jr., et al., 250/423R; 315/111.81 [IMAGE AVAILABLE]

=> s 19 and electrochromic

1419.ELECTROCHROMIC

L10 0 L9 AND ELECTROCHROMIC

=> s 19 and lithium

68632 LITHIUM

L11 5 L9 AND LITHIUM

=> d 111 1-5

1. 5,061,569, Oct. 29, 1991, Electroluminescent device with organic electroluminescent medium; Steven A. VanSlyke, et al., 428/457; 252/301.16; 313/504, 506; 428/515, 690, 917 [IMAGE AVAILABLE]

2. 4,950,950, Aug. 21, 1990, Electroluminescent device with silazane-containing luminescent zone; Robert J. Perry, et al.,

313/504, 506; 428/690, 917 [IMAGE AVAILABLE]

3. 4,885,211, Dec. 5, 1989, Electroluminescent device with improved cathode; Ching W. Tang, et al., 428/457; 252/301.16; 313/346R, 498, 504, 506, 507; 428/411.1, 461, 515, 917 [IMAGE AVAILABLE]

4. 4,769,292, Sep. 6, 1988, Electroluminescent device with modified thin film luminescent zone; Ching W. Tang, et al., 428/690; 313/504; 428/917 [IMAGE AVAILABLE]

5. 4,720,432, Jan. 19, 1988, Electroluminescent device with organic luminescent medium; Steven A. VanSlyke, et al., 428/457; 252/301.16; 257/40, 103; 313/498, 504, 506, 509; 428/411.1, 461, 515, 917 [IMAGE AVAILABLE]

=> s 19 and smart window?

2216 SMART
111108 WINDOW?
28 SMART WINDOW?
(SMART(W)WINDOW?)
L12 0 L9 AND SMART WINDOW?

=> s smart window?

2216 SMART
111108 WINDOW?
L13 28 SMART WINDOW?
(SMART(W)WINDOW?)

=> s 113 and anode and cathode

58810 ANODE
82060 CATHODE
L14 2 L13 AND ANODE AND CATHODE

=> d 114 1-2

1. 5,351,151, Sep. 27, 1994, Optical filter using microlens arrays; George S. Levy, 359/240, 237, 252, 256, 259, 275, 276, 282, 284, 419 [IMAGE AVAILABLE]

2. 5,338,625, Aug. 16, 1994, Thin film battery and method for making same; John B. Bates, et al., 429/193, 127 [IMAGE AVAILABLE]

=> s 113 and electrolyte

30848 ELECTROLYTE
L15 14 L13 AND ELECTROLYTE

=> s 115 and lithium

68632 LITHIUM
L16 10 L15 AND LITHIUM

=> s 116 and vanadium oxide

22589 VANADIUM
240069 OXIDE

L7 0 L2 AND L3 AND L4

=> s 12 and 13 and 15

L8 0 L2 AND L3 AND L5

=> s 12 and 13

L9 7 L2 AND L3

=> d 19 1-7

1. 5,061,569, Oct. 29, 1991, Electroluminescent device with organic electroluminescent medium; Steven A. VanSlyke, et al., 428/457; 252/301.16; 313/504, 506; 428/515, 690, 917 [IMAGE AVAILABLE]

2. 4,950,950, Aug. 21, 1990, Electroluminescent device with silazane-containing luminescent zone; Robert J. Perry, et al., 313/504, 506; 428/690, 917 [IMAGE AVAILABLE]

3. 4,885,211, Dec. 5, 1989, Electroluminescent device with improved cathode; Ching W. Tang, et al., 428/457; 252/301.16; 313/346R, 498, 504, 506, 507; 428/411.1, 461, 515, 917 [IMAGE AVAILABLE]

4. 4,769,292, Sep. 6, 1988, Electroluminescent device with modified thin film luminescent zone; Ching W. Tang, et al., 428/690; 313/504; 428/917 [IMAGE AVAILABLE]

5. 4,720,432, Jan. 19, 1988, Electroluminescent device with organic luminescent medium; Steven A. VanSlyke, et al., 428/457; 252/301.16; 257/40, 103; 313/498, 504, 506, 509; 428/411.1, 461, 515, 917 [IMAGE AVAILABLE]

6. 4,360,763, Nov. 23, 1982, Method and device for control of great currents particularly of the pulse type; Michal Gryzinski, 315/111.01; 200/144B; 313/231.01; 315/344 [IMAGE AVAILABLE]

7. 4,045,677, Aug. 30, 1977, Intense ion beam generator; Stanley Humphries, Jr., et al., 250/423R; 315/111.81 [IMAGE AVAILABLE]

=> s 19 and electrochromic

L10 1419 ELECTROCHROMIC
0 L9 AND ELECTROCHROMIC

=> s 19 and lithium

L11 68632 LITHIUM
5 L9 AND LITHIUM

=> d 111 1-5

1. 5,061,569, Oct. 29, 1991, Electroluminescent device with organic electroluminescent medium; Steven A. VanSlyke, et al., 428/457; 252/301.16; 313/504, 506; 428/515, 690, 917 [IMAGE AVAILABLE]

2. 4,950,950, Aug. 21, 1990, Electroluminescent device with silazane-containing luminescent zone; Robert J. Perry, et al.,

313/504, 506; 428/690, 917 [IMAGE AVAILABLE]

3. 4,885,211, Dec. 5, 1989, Electroluminescent device with improved cathode; Ching W. Tang, et al., 428/457; 252/301.16; 313/346R; 498, 504, 506, 507; 428/411.1, 461, 515, 917 [IMAGE AVAILABLE]

4. 4,769,292, Sep. 6, 1988, Electroluminescent device with modified thin film luminescent zone; Ching W. Tang, et al., 428/690; 313/504; 428/917 [IMAGE AVAILABLE]

5. 4,720,432, Jan. 19, 1988, Electroluminescent device with organic luminescent medium; Steven A. VanSlyke, et al., 428/457; 252/301.16; 257/40, 103; 313/498, 504, 506, 509; 428/411.1, 461, 515, 917 [IMAGE AVAILABLE]

=> s 19 and smart window?

2216 SMART

111108 WINDOW?

28 SMART WINDOW?

(SMART(W)WINDOW?)

L12 0 L9 AND SMART WINDOW?

=> s smart window?

2216 SMART

111108 WINDOW?

L13 28 SMART WINDOW?

(SMART(W)WINDOW?)

=> s 113 and anode and cathode

58810 ANODE

82060 CATHODE

L14 2 L13 AND ANODE AND CATHODE

=> d 114 1-2

1. 5,351,151, Sep. 27, 1994, Optical filter using microlens arrays; George S. Levy, 359/240, 237, 252, 256, 259, 275, 276, 282, 284, 419 [IMAGE AVAILABLE]

2. 5,338,625, Aug. 16, 1994, Thin film battery and method for making same; John B. Bates, et al., 429/193, 127 [IMAGE AVAILABLE]

=> s 113 and electrolyte

30848 ELECTROLYTE

L15 14 L13 AND ELECTROLYTE

=> s 115 and lithium

68632 LITHIUM

L16 10 L15 AND LITHIUM

=> s 116 and vanadium oxide

22589 VANADIUM

240069 OXIDE

L7 0 L2 AND L3 AND L4

=> s 12 and 13 and 15

L8 0 L2 AND L3 AND L5

=> s 12 and 13

L9 7 L2 AND L3

=> d 19 1-7

1. 5,061,569, Oct. 29, 1991, Electroluminescent device with organic electroluminescent medium; Steven A. VanSlyke, et al., 428/457; 252/301.16; 313/504, 506; 428/515, 690, 917 [IMAGE AVAILABLE]

2. 4,950,950, Aug. 21, 1990, Electroluminescent device with silazane-containing luminescent zone; Robert J. Perry, et al., 313/504, 506; 428/690, 917 [IMAGE AVAILABLE]

3. 4,885,211, Dec. 5, 1989, Electroluminescent device with improved cathode; Ching W. Tang, et al., 428/457; 252/301.16; 313/346R, 498, 504, 506, 507; 428/411.1, 461, 515, 917 [IMAGE AVAILABLE]

4. 4,769,292, Sep. 6, 1988, Electroluminescent device with modified thin film luminescent zone; Ching W. Tang, et al., 428/690; 313/504; 428/917 [IMAGE AVAILABLE]

5. 4,720,432, Jan. 19, 1988, Electroluminescent device with organic luminescent medium; Steven A. VanSlyke, et al., 428/457; 252/301.16; 257/40, 103; 313/498, 504, 506, 509; 428/411.1, 461, 515, 917 [IMAGE AVAILABLE]

6. 4,360,763, Nov. 23, 1982, Method and device for control of great currents particularly of the pulse type; Michal Gryzinski, 315/111.01; 200/144B; 313/231.01; 315/344 [IMAGE AVAILABLE]

7. 4,045,677, Aug. 30, 1977, Intense ion beam generator; Stanley Humphries, Jr., et al., 250/423R; 315/111.81 [IMAGE AVAILABLE]

=> s 19 and electrochromic

1419 ELECTROCHROMIC

L10 0 L9 AND ELECTROCHROMIC

=> s 19 and lithium

68632 LITHIUM

L11 5 L9 AND LITHIUM

=> d 111 1-5

1. 5,061,569, Oct. 29, 1991, Electroluminescent device with organic electroluminescent medium; Steven A. VanSlyke, et al., 428/457; 252/301.16; 313/504, 506; 428/515, 690, 917 [IMAGE AVAILABLE]

2. 4,950,950, Aug. 21, 1990, Electroluminescent device with silazane-containing luminescent zone; Robert J. Perry, et al.,

=> s (phosphorus or P) (4a) (oxynitride or no) (4a) (lithium or li)
53950 PHOSPHORUS
472558 P

1564 OXYNITRIDE
1462158 NO

68632 LITHIUM
21130 LI

L1 45 (PHOSPHORUS OR P) (4A) (OXYNITRIDE OR NO) (4A) (LITHIUM OR
LI)

=> s l1 and electrolyte

30848 ELECTROLYTE

L2 6 L1 AND ELECTROLYTE

=> d l2 1-6

1. 5,338,625, Aug. 16, 1994, Thin film battery and method for making
same; John B. Bates, et al., 429/193, 127 [IMAGE AVAILABLE]

2. 5,314,765, May 24, 1994, Protective lithium ion conducting ceramic
coating for lithium metal anodes and associate method; John B. Bates,
429/194; 29/623.5; 429/48, 218 [IMAGE AVAILABLE]

3. 5,288,678, Feb. 22, 1994, Indirect potentiometric method and diluent
for analysis of lithium; Frank R. Shu, et al., 436/18; 204/153.15;
436/79, 150, 179 [IMAGE AVAILABLE]

4. 5,114,809, May 19, 1992, All solid-state lithium secondary battery;
Yoshifumi Nakacho, et al., 429/192, 218 [IMAGE AVAILABLE]

5. 5,110,742, May 5, 1992, Indirect potentiometric method and diluent
for analysis of lithium; Frank R. Shu, et al., 436/18; 204/153.15;
436/150, 182 [IMAGE AVAILABLE]

6. 4,961,859, Oct. 9, 1990, Method of treating an aqueous processing
waste solution of a non-silver halide light-sensitive material and a
device therefor; Masafumi Uehara, et al., 210/725; 159/47.3; 203/14;
210/178, 182, 207, 724, 727, 734, 737, 774, 787, 803 [IMAGE AVAILABLE]
=> s l1 and electrochromic

1419 ELECTROCHROMIC

L3 1 L1 AND ELECTROCHROMIC

=> d l3 1

1. 5,338,625, Aug. 16, 1994, Thin film battery and method for making
same; John B. Bates, et al., 429/193, 127 [IMAGE AVAILABLE]
=> s lithium phosphorus oxynitride.

68632 LITHIUM

53950 PHOSPHORUS

1564 OXYNITRIDE

L4 2 LITHIUM PHOSPHORUS OXYNITRIDE

(LITHIUM(W)PHOSPHORUS(W)OXYNITRIDE)

=> d l4 1-2

1. 5,338,625, Aug. 16, 1994, Thin film battery and method for making
same; John B. Bates, et al., 429/193, 127 [IMAGE AVAILABLE]

2. 5,314,765, May 24, 1994, Protective lithium ion conducting ceramic coating for lithium metal anodes and associate method; John B. Bates, 429/194; 29/623.5; 429/48, 218 [IMAGE AVAILABLE]

=> logoff y

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Form PTO-477A

1/16/94

U.S. DEPT. OF COMMERCE
PATENT & TRADEMARK OFFICE

APPLICATION TRANSFER REQUEST

Section I. APPLICATION TRANSFER REQUEST

TO: Receiving A.U. 1111 Date 6/29 S.N. 2407359

FROM: Originating A.U. 3206 Class/sub 29 Examiner 1100

REASON: claims 27-29 are not new ☐ Request for Reconsideration (Return to Classification)

Section II. DISPOSITION BY RECEIVING A.U.

☒ Accepted (keep in receiving A.U.) Date 6/30/94 Ext. Willis

☐ Not Accepted ☒ Forward to Chen Doc DOC

REASON: Appears to be 359/2651 for electronic cell

☐ Return to Originating A.U. ☐ Classification Group

☐ Nonclassification issue only: ☐ Restriction ☐ Other

Section III. DISPOSITION BY

☒ Transfer Approved-Forward to A.U. 1111 Class/sub 29 Date 8/15/94 Classifier J. McE...

☐ Transfer Disapproved-Forward to Originating A.U. 1111 Concurring J. McE...

REASON: Appears appropriate. Please consider

☐ Nonclassification issue raised: ☐ Restriction ☐ Other

Supplies to Front of Application

APPLICATION TRANSFER REQUEST

FORM PTO-447A

9-13

Section I. APPLICATION TRANSFER REQUEST Date 9/6/94 S.N. 08/248,935

TO: Receiving Chem. Doc. Class/sub _____ Examiner _____

FROM: Originaling A.U. 1111 Class/sub _____ Examiner _____

REASON: ☒ Request for Reconsideration (Return to Classification)

Claims 1-26 and 30 have been cancelled. The only claims under consideration are claims 27-29. The claims are not directed to the film battery. Please reconsider 359/265+ as a place for these claims.

Section II. DISPOSITION BY RECEIVING A.U. Date _____ Ext' _____

☐ Accepted (keep in receiving A.U.)

Not Accepted ☐ Forward to _____ Classification Group _____

☐ Return to Originating A.U. _____ Nonclassification issue only:

☐ Restriction

☐ Other

REASON:

Section III. DISPOSITION BY C/E Classification Group. Date 9/14/94

☐ Transfer Approved-Forward to A.U. _____ Class/sub 429 Classifier J. C. Hor

☒ Transfer Disapproved-Forward to Originating A.U. 1111 Concurring _____

REASON:

Nonclassification issue raised: ☐ Restriction

☐ Other

All that is recited in claims 27-29 is a thin film battery. No other pertinent structure for 359.

Staple to Front of Application

APPLICATION TRANSFER REQUEST

U.S. DEPARTMENT OF COMMERCE
PATENT & TRADEMARK OFFICESection I. APPLICATION TRANSFER REQUEST Date 8/23/94 S.N. 08/248,935TO: Receiving ~~APP~~ Chem DOC Class/sub _____ Examiner _____FROM: Originating A.U. 1111 Class/sub 429 Examiner ?REASON: ☒ Request for Reconsideration (Return to Classification)

The claims under consideration are 27-29 claims 1-26 and 30 will be cancelled. There is not sufficient battery structure in the remaining claims 27-29 to warrant classification in 429. I suggest that the classifier reconsider the suggested 359 classification. It does not conform with 359 classification. Please provide explanation as to why claims should go in 429.

Section II. DISPOSITION BY RECEIVING A.U. Date _____ Ext _____

☒ Accepted (keep in receiving A.U.)Not Accepted ☐ Forward to _____ Classification Group _____☐ Return to Originating A.U. _____ Nonclassification Issue only:REASON: ☐ Restriction ☐ OtherSection III. DISPOSITION BY C/E Classification Group: _____ Date 9/1/94☐ Transfer Approved-Forward to A.U. 429 Class/sub 429 Classifier F. O'Brien☒ Transfer Disapproved-Forward to Originating A.U. 1111 Concurring _____REASON: Nonclassification issue raised: ☐ Restriction ☐ Other

See APS search on thin film batteries. Search shows there is considerable art in 429, see e.g., 5114809, 5338625, 5342409.



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER OF
PATENTS AND TRADEMARKS
Washington, D.C. 20231

#9

George L. Craig
Martin Marietta Engergy Systems, Inc.
P.O. Box 2009
Oak Ridge, TN 37831-8243

MAILED
SEP 20 1995
GROUP 1100

Serial No. 08/248,935 :
Filed: May 25, 1994 : DECISION ON PETITION
For: An Electro-Optical Device :
Including A Nitrogen Containing: :
Electrolyte :

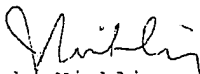
This is a decision on the Petition, filed August 14, 1995, to
delete Inventors under 37 CFR 1.48.

The Petition is GRANTED.

In view of the papers filed August 14, 1995, it has been found
that this application, as filed, through error and without any
deceptive intent, improperly set forth the inventorship, and
accordingly, this application has been corrected in compliance
with 37 CFR 1.48(a). The Inventorship of this application has
been changed by deletion of inventors Christopher F. Luck and
Greg R. Gruzalski.

The Petition is GRANTED.

The application is being forwarded to Application Branch for
correction of data on the front jacket of the file.


John Niebling
Supervisory Primary Examiner
Patent Examining Group 1100



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Division patent application
of Parent Patent Application
Serial No. 07/921,538 filed
July 29, 1992, and issued
August 16, 1994 as U.S.
Patent No. 5,338,625

Applicants: John B. Bates
Nancy J. Dudney

Serial No.: 08/248,935

Filing Date: June 29, 1994

Title: A ELECTRO-OPTICAL DEVICE

Docket No.: 957-X-7

Examiner: B. Bell

Art Unit: 1102

7550 12/85
100-84418
M.H.
9/20/95
RECEIVED
AUG 23 1995
GROUP 1100

PETITION AND FEE DELETING CORRECTLY NAMED ORIGINAL PERSON(S) WHO
ARE NOT INVENTOR(S) OF INVENTION NOW BEING CLAIMED (37 CFR 1.48(b))

Honorable Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir:

This petition under 37 CFR 1.48(b) is to delete the names of the following persons
originally named as inventors in the parent application and who are not the inventors of
the invention now being claimed:

Christopher F. Luck
Greg R. Gruzalski

The claims in this application are as follows:

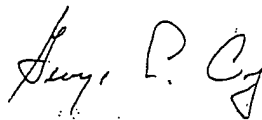
Claims 1-26 and 30 were cancelled and Claims 27-29 remained of the original
Claims 1-30 upon filing this application as a divisional application on May 25, 1994.

This petition is being filed diligently after discovery of any claim(s) for which the above-
named inventors, who are now being deleted, are now no longer the inventors of the
subject matter being claimed. The facts involved are now set forth as follows:

RECEIVED

In the Office Action on the parent application dated 28 May 1993, the Examiner issued a restriction to the filed claims under 35 USC 121 as follows: Group I (Claims 1-7 and 30) drawn to an electrochemical cell; Group II (Claims 8-12) drawn to a method for making an electrochemical cell; Group III (Claims 13-15) drawn to an electrolyte; Group IV (Claims 16-19) drawn to a method for making an electrolyte; Group V (Claims 20-22) drawn to a cathode; Group VI (Claims 23-26) drawn to a method of making a cathode; and Group VII (Claims 27-29) drawn to an electro-optical device. Accordingly, Applicants cancelled Claims 8-29 and elected to first prosecute the claims of Group I. Applicants also filed divisional applications on each of the other Groups of Claims. In the present application directed to the Group VII Claims, upon cancellation of the non-elected Claims 1-26 and 30, Christopher F. Luck and Greg R. Gruzalski are no longer inventors of the remaining claims 27-29. Therefore, this formal petition to delete Christopher F. Luck and Greg R. Gruzalski as inventors is being diligently submitted.

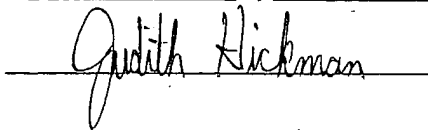
Applicants respectfully submit that this petition for change of inventorship was not the result of error on Applicants' part since the cover sheet of the preliminary amendment and the post card accompanying the amendment and application for filing the divisional application (attached) correctly name the proper inventors of the claimed subject matter. However, if such a petition fee for correction of inventorship should be required, please charge the fee required by 37 CFR 1.17(h) to Deposit Account 13-1958.



George L. Craig, Esq.
Patent Counsel
Reg. No. 29,293
Lockheed Martin Energy Systems, Inc.
Post Office Box 2009
Oak Ridge, Tennessee 37831-8243
Telephone No. (615) 576-9676
Facsimile No. (615) 574-0381

Certificate of Mailing

I hereby certify that this correspondence is being deposited with the U.S. Postal Service as First-Class Mail in an envelope addressed to Commissioner of Patents and Trademarks, Washington, D.C. 20231, on August 10, 1995, by Judith Hickman.



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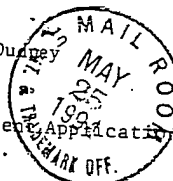
AUG 23 1993

GROUP 1100

DOCKET NO.: 957-X-7

APPLICANTS: John B. Bates and Nancy J. Dudgey

TITLE: AL ELECTRO-OPTICAL DEVICE



- Divisional Patent Application of U.S. Patent Application
- Serial No. 07/921,538 filed July 29, 1992.

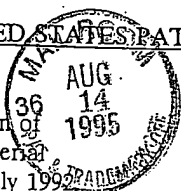
The date-stamping of this card acknowledges receipt of
the following:

- 1) Request for Filing a Patent Application Under
37 CFR 1.60
- 2) Preliminary Amendment
- 3) Copy - U.S. Patent Application Serial No. 07/921,538
- 4) Copy - Combined Declaration and Power of Attorney

08/248935

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Division patent application of
U.S. Patent Application Serial
No. 07/921,538 filed 29 July 1992



Docket No.: 957-X-7

Examiner: S. Barts

Art Unit: 1204

John B. Bates
Nancy J. Dudney

Serial No.:

Filing Date:

Title: THIN FILM BATTERY AND
METHOD FOR MAKING SAME

RECEIVED

AUG 23 1995

GROUP 1100

PRELIMINARY AMENDMENT UNDER 37 C.F.R. 1.115

Honorable Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir:

Submitted herewith is a preliminary amendment under 37 C.F.R. 1.115 requesting that the specification and claims of the present divisional patent application be amended as follows:

In the Specification

Delete the title and substitute --An Electro-Optical Device--.

Page 1, before the first sentence of the first paragraph, insert --This application is a division of application Serial No. 07/921,538, filed 29 July 1992, presently pending.--

In the Claims

Please cancel Claims 1-26 and 30.

instah... nat... of s... of wh... er and

PART B—ISSUE FEE TRANSMITTAL

MAILING INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE. Blocks 2 through 6 should be completed where appropriate. All further correspondence including the Issue Fee Receipt, the Patent, advance orders and notification of maintenance fees will be mailed to addressee entered in Block 1 unless you direct otherwise, by: (a) specifying a new correspondence address in Block 3 below; or (b) providing the PTO with a separate "FEE ADDRESS" for maintenance fee notifications with the payment of Issue Fee or thereafter. See reverse for Certificate of Mailing.

1. CORRESPONDENCE ADDRESS		2. INVENTOR(S) ADDRESS CHANGE (Complete only if there is a change)	
<p>GEORGE L. CRAIG MARTIN MARIETTA ENERGY SYSTEMS, INC. P. O. BOX 2009 OAK RIDGE, TN 37831-8243</p>		INVENTOR'S NAME	
		Street Address	
		City, State and ZIP Code	
		CO-INVENTORS NAME	
		Street Address	
		City, State and ZIP Code	
<input type="checkbox"/> Check if additional changes are on reverse side			

SERIES CODE/SERIAL NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
09/24/93	05/25/94	002	BELL E	1102 03/17/94

First Named Applicant: DATES, JOHN D.

TITLE OF INVENTION
AN ELECTRO-OPTICAL DEVICE INCLUDING A NITROGEN CONTAINING ELECTROLYTE (AS AMENDED)

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
1 957X7	429-127.000	173	UTILITY	NO	\$1210.00	06/19/95

3. Correspondence address change (Complete only if there is a change)	4. For printing on the patent front page, list the names of not more than 3 registered patent attorneys or agents OR, alternatively, the name of a firm having as a member a registered attorney or agent. If no name is listed, no name will be printed.
Harold W. Adams Associate General Counsel for Intellectual Property Lockheed Martin Energy Systems, Inc. P.O. Box 2009 Oak Ridge, TN 37831-8243	1 George L. Craig 2 James M. Spicer 3 Harold W. Adams

DO NOT USE THIS SPACE

TL60730	07/20/95	08248935	13-1958	060	142	1,210.00CH
TL60731	07/20/95	08248935	13-1958	060	561	30.00CH

5. ASSIGNMENT DATA TO BE PRINTED ON THE PATENT (print or type)

(1) NAME OF ASSIGNEE: Martin Marietta Energy Systems, Inc.
(2) ADDRESS: (CITY & STATE OR COUNTRY): Oak Ridge, Tennessee

5a. The following fees are enclosed:
☒ Issue Fee ☒ Advance Order - # of Copies 10
 5b. The following fees should be charged to:
 DEPOSIT ACCOUNT NUMBER 13-1958
 (ENCLOSE PART C)
☒ Issue Fee ☒ Advance Order - # of Copies 10
☐ Any Delinquencies in Enclosed Fees

The COMMISSIONER OF PATENTS AND TRADEMARKS is requested to apply the Issue Fee to the application identified above.

(Authorized Signature) *Proctor* (Date) 6/16/95

NOTE: The Issue Fee will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the Patent and Trademark Office.

- A. ☐ This application is NOT assigned.
☐ Assignment previously submitted to the Patent and Trademark Office.
☒ Assignment is being submitted under separate cover. Assignments should be directed to Box ASSIGNMENTS.

PLEASE NOTE: Unless an assignee is identified in Block 5, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the PTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

1. TRANSMIT THIS FORM WITH FEE-CERTIFICATE OF MAILING ON REVERSE

ROOM
JUN 22 1995

ad for PART C CHARGE TO DEPOSIT ACCOUNT

B

1. CORRESPONDENCE ADDRESS

GEORGE L. CRAIG
MARTIN MARIETTA ENERGY SYSTEMS, INC.
P. O. BOX 2009
OAK RIDGE, TN 37831-8243

D1M1/0317

CE

625

1210

SERIES CODE/SERIAL NO. (4) FILING DATE TOTAL CLAIMS EXAMINER AND GROUP ART UNIT DATE MAILED

09/24/94 05/25/94 002 DELL, D 1102 03/17/95

First Named Applicant DATE: JOHN B.

TITLE OF INVENTION AN ELECTRA-OPTICAL DEVICE INCLUDING A NITROGEN CONTAINING ELECTROLYTE (AS AMENDED)

ATTY'S DOCKET NO. CLASS-SUBCLASS BATCH NO. APPLN. TYPE SMALL ENTITY FEE DUE DATE DUE

05747 429 127,000 13-1958 UTILITY NO \$1,210.00 06/19/95

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TL60730 07/20/95 08248935
TL60731 07/20/95 08248935

13-1958 060 142 1,210.00CH
13-1958 060 541 30.00CH

2a. The following fees are enclosed:
- ☒ Issue Fee - ☒ Advance Order - # of Copies 10
2b. The following fees should be charged to:
DEPOSIT ACCOUNT NUMBER 13-1958
☒ Issue Fee ☒ Advance Order - # of Copies 10
☒ Any Delinquencies in Enclosed Fees
The COMMISSIONER OF PATENTS AND TRADEMARKS is requested to apply the Issue Fee to the application identified above.
(Authorized Signature)
Pat L. Smith

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2. TRANSMIT THIS FORM WITH PART B WHEN AUTHORIZING USE OF A DEPOSIT ACCOUNT

PTOL-85C (REV.12-93)(0651-0033)

B

PARTIAL CHARGE TO DEPOSIT ACCOUNT

ROOM JUN 1992 65

1. CORRESPONDENCE ADDRESS

D1M1/0317

GEORGE L. CRAIG
MARTIN MARIETTA ENERGY SYSTEMS, INC.
P. O. BOX 2009
OAK RIDGE, TN 37831-8243

CE 125 1210

SERIES CODE/SERIAL NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP/ART UNIT	DATE MAILED
02/142 425	05/25/94	002	BELL, B	1102 02/17/95

First Named Applicant: RATES, JOHN D.

TITLE OF INVENTION: AN ELECTRO-OPTICAL DEVICE INCLUDING A NITROGEN CONTAINING ELECTROLYTE (AS AMENDED)

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
021247	422-127-000	175	UTILITY	NO	\$1210.00	05/13/95

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18 3

TL60730 07/20/95 06248935	13-1958 060 142	1,710.00CH.
TL60731 07/20/95 08248935	13-1958 060 561	30.00CH

N 3

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2b. The following fees should be charged to:
DEPOSIT ACCOUNT NUMBER 13-1958

☒ Issue Fee ☒ Advance Order - # of Copies 10
☒ Any Deficiencies in Enclosed Fees

The COMMISSIONER OF PATENTS AND TRADEMARKS is requested to apply the Issue Fee to the application identified above.
(Authorized Signature)

NOTE: The Issue Fee will not be accepted from anyone other than the applicant, a registered attorney or agent, or the assignee or other party in interest as shown by the records of the Patent and Trademark Office.

2. TRANSMIT THIS FORM WITH PART B WHEN AUTHORIZING USE OF A DEPOSIT ACCOUNT

PTOL-85C (REV.12-93)(0651-0033)

Certificate of Mailing

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to:

Box ISSUE FEE
Commissioner of Patents and Trademarks
Washington, D.C. 20231

on June 19, 1995
(Date)

Judith Hickman
(Name of person making deposit)

Judith Hickman
(Signature)

6/19/95
(Date)

Note: If this certificate of mailing is used, it can only be used to transmit the Issue Fee. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing.

Burden Hour Statement: This form is estimated to take .2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Office of Information Systems, Patent and Trademark Office, Washington, D.C. 20231, and to the Office of Information and Regulatory Affairs, Office of Management and Budget, (Project 0651-0033), Washington, D.C. 20503. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner of Patents and Trademarks, Box Issue Fee, Washington, DC 20231.



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

Address: Box ISSUE FEE
COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

BOONAN L. CHAILO
REPAIR METHOD FOR ENERGY SYSTEMS, INC.
P.O. BOX 2004
MILWAUKEE, WI 53201-0004

NOTICE OF ALLOWANCE
AND ISSUE FEE DUE

- ☐ Note attached communication from the Examiner
☐ This notice is issued in view of applicant's communication filed

SERIES CODE/SERIAL NO.	FILED DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
First Named Applicant				

TITLE OF INVENTION

REPAIR METHOD FOR ENERGY SYSTEMS, INC.
(SEE SPECIFICATION)

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPLN. TYPE	SMALL ENTITY	FEE DUE	DATE DUE

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT.
PROSECUTION ON THE MERITS IS CLOSED.

THE ISSUE FEE MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED.

HOW TO RESPOND TO THIS NOTICE:

- I. Review the SMALL ENTITY Status shown above.
If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:
 - A. If the status is changed, pay twice the amount of the FEE DUE shown above and notify the patent and Trademark Office of the change in status, or
 - B. If the Status is the same, pay the FEE DUE shown above.
- II. Part B of this notice should be completed and returned to the Patent and Trademark Office (PTO) with your ISSUE FEE. Even if the ISSUE FEE has already been paid by charge to deposit account, Part B should be completed and returned. If you are charging the ISSUE FEE to your deposit account, Part C of this notice should also be completed and returned.
- III. All communications regarding this application must give series code (or filing date), serial number and batch number. Please direct all communication prior to issuance to Box ISSUE FEE unless advised to contrary.

If the SMALL ENTITY is shown as NO:
A. Pay FEE DUE shown above, or
B. File verified statement of Small Entity Status before, or with, pay of 1/2 the FEE DUE shown above.

IMPORTANT REMINDER: Patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.



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SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
08/248,935	05/25/94	BATES	J 957X7

D1M1/0317

GEORGE L. CRAIG
MARTIN MARIETTA ENERGY SYSTEMS, INC.
P. O. BOX 2009
OAK RIDGE, TN 37831-8243

BELL, EXAMINER

ART UNIT	PAPER NUMBER
1102	5

DATE MAILED: 03/17/95

NOTICE OF ALLOWABILITY

PART I.

1. ☒ This communication is responsive to The amendment filed March 3, 1995
2. ☒ All the claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice Of Allowance And Issue Fee Due or other appropriate communication will be sent in due course.
3. ☒ The allowed claims are 27-29
4. ☐ The drawings filed on _____ are acceptable.
5. ☐ Acknowledgment is made of the claim for priority under 35 U.S.C. 119. The certified copy has ☐ been received. ☐ not been received. ☐ been filed in parent application Serial No. _____, filed on _____
6. ☐ Note the attached Examiner's Amendment.
7. ☒ Note the attached Examiner Interview Summary Record, PTOL-413.
8. ☐ Note the attached Examiner's Statement of Reasons for Allowance.
9. ☐ Note the attached NOTICE OF REFERENCES CITED, PTO-892.
10. ☐ Note the attached INFORMATION DISCLOSURE CITATION, PTO-1449.

PART II.

A SHORTENED STATUTORY PERIOD FOR RESPONSE to comply with the requirements noted below is set to EXPIRE THREE MONTHS FROM THE "DATE MAILED" indicated on this form. Failure to timely comply will result in the ABANDONMENT of this application. Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

1. ☐ Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL APPLICATION, PTO-152, which discloses that the oath or declaration is deficient. A SUBSTITUTE OATH OR DECLARATION IS REQUIRED.
2. ☐ APPLICANT MUST MAKE THE DRAWING CHANGES INDICATED BELOW IN THE MANNER SET FORTH ON THE REVERSE SIDE OF THIS PAPER.
 - a. ☐ Drawing informalities are indicated on the NOTICE RE PATENT DRAWINGS, PTO-948, attached hereto or to Paper No. _____. CORRECTION IS REQUIRED.
 - b. ☐ The proposed drawing correction filed on _____ has been approved by the examiner. CORRECTION IS REQUIRED.
 - c. ☐ Approved drawing corrections are described by the examiner in the attached EXAMINER'S AMENDMENT. CORRECTION IS REQUIRED.
 - d. ☐ Formal drawings are now REQUIRED.

Any response to this letter should include in the upper right hand corner, the following information from the NOTICE OF ALLOWANCE AND ISSUE FEE DUE: ISSUE BATCH NUMBER, DATE OF THE NOTICE OF ALLOWANCE, AND SERIAL NUMBER.

Attachments:

- | | |
|---|--|
| <input checked="" type="checkbox"/> Examiner's Amendment | <input type="checkbox"/> Notice of Informal Application, PTO-152 |
| <input checked="" type="checkbox"/> Examiner Interview Summary Record, PTOL-413 | <input type="checkbox"/> Notice re Patent Drawings, PTO-948 |
| <input type="checkbox"/> Reasons for Allowance | <input type="checkbox"/> Listing of Bonded Draftsmen |
| <input type="checkbox"/> Notice of References Cited, PTO-892 | <input type="checkbox"/> Other |
| <input type="checkbox"/> Information Disclosure Citation, PTO-1449 | |

Kathryn Gorgos
KATHRYN GORGOS
PRIMARY EXAMINER
GROUP 1100



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Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
08/248935	5/25/94	Gates	957x7

EXAMINER

B. Bell

ART UNIT	PAPER NUMBER
----------	--------------

1102

5

DATE MAILED:

EXAMINER INTERVIEW SUMMARY RECORD

All participants (applicant, applicant's representative, PTO personnel):

(1) Mr. George Craig (3) _____
(2) Bruce Bell (4) _____

Date of interview 2-28-95

Type: ☒ Telephonic ☐ Personal (copy is given to ☐ applicant ☐ applicant's representative).

Exhibit shown or demonstration conducted: ☐ Yes ☒ No. If yes, brief description: _____

Agreement ☒ was reached with respect to some or all of the claims in question. ☐ was not reached.

Claims discussed: all

Identification of prior art discussed: none

Description of the general nature of what was agreed to if an agreement was reached, or any other comments: discussed inclusion
into specification that all known ^{conventional} electrochromic materials could be
chosen in the applicants device and that the novelty is in
the inclusion of nitrogen into the electrolyte

(A fuller description, if necessary, and a copy of the amendments, if available, which the examiner agreed would render the claims allowable must be attached. Also, where no copy of the amendments which would render the claims allowable is available, a summary thereof must be attached.)

☐ 1. It is not necessary for applicant to provide a separate record of the substance of the interview.

Unless the paragraph below has been checked to indicate to the contrary, A FORMAL WRITTEN RESPONSE TO THE LAST OFFICE ACTION IS NOT WAIVED AND MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW (e.g., items 1-7 on the reverse side of this form). If a response to the last Office action has already been filed, then applicant is given one month from this interview date to provide a statement of the substance of the interview.

☐ 2. Since the examiner's interview summary above (including any attachments) reflects a complete response to each of the objections, rejections and requirements that may be present in the last Office action, and since the claims are now allowable, this completed form is considered to fulfill the response requirements of the last Office action. Applicant is not relieved from providing a separate record of the substance of the interview unless box 1 above is also checked.

PTOL-413 (REV. 2-93)

Examiner's Signature

ORIGINAL FOR INSERTION IN RIGHT HAND FLAP OF FILE WRAPPER

EXHIBIT "F"

DOCKET 7310 No. 09/037,801
Assigned to Examiners NUZZOLILLO and ALEJANDRO

<u>Filed</u>	3/10/98	
<u>Restriction</u>	9/9/99	Twenty Three way restriction of Claims 1-102.
<u>Office Action</u>	11/24/99	Elected Claims 33-40 rejected by Examiner Alejandro under § 103(a) Hockaday 5,759,712 in view of Hockaday 5,631,099.
<u>Petition</u>	12/9/99	Petition to vacate restriction
<u>Office Action</u>	2/23/00	Petition to vacate restriction granted Five way restriction made. Elected Claims 10-43, 51-54, 89-92 and 94-97 rejected by Examiner Alejandro under § 103(a) Hockaday 5,759,712 in view of Hockaday 5,631,099.
<u>Amendment & Decl.</u>	3/7/00	Amendment Elected Claims and argument Declaration of Dr. LaFollette
<u>Interview</u>	5/3/00	Interview. Hockaday 5,759,712 removed by Examiner Nuzzolillo because it concerns a fuel cell, not a battery.
<u>Supplemental Amendment</u>	5/5/00	Two Claims amended.
<u>Office Action</u>	5/17/00	Office Action. Hockaday references dropped. Claims 10-43, 51-54, 89-92 and 94-97 rejected by Examiner Alejandro under § 103(a) on Arledge 5,437,941.
<u>Amendment & Decl.</u>	8/15/00	Amendment. Non-elected Claims 1-9, 44-50, 55-88, 93 and 98-107 cancelled without prejudice. Some elected Claims amended. Claims 103-109 added. Second Declaration of Dr. LaFollette.
<u>Office Action</u>	10/20/00	Final Office Action. Claims 10-43, 51-54, 89-92, 94-97 and 103-109 rejected by Examiner Alejandro under § 103(a) on Arledge 5,437,941.
<u>After Final Amendment & Decl.</u>	12/15/00	Amendment. Amended some Claims. Third Declaration of Dr. LaFollette.
<u>Interview</u>	12/18/00	Interview promising re-evaluation of rejection.
<u>Interview Summary</u>	12/19/00	Applicants' Summary of Interview/ Request Final be withdrawn.
<u>Advisory</u>	12/26/00	Advisory refusing to re-evaluate rejection and refusing to enter Amendment of 12/15/00.
<u>C.P.A.</u>	1/11/01	Continued Prosecution Application filed.
<u>Office Action</u>	2/20/01	Office Action. Claims 10-12, 15-43, 51-54, 89-92 and 103-109 rejected by Examiner Alejandro under § 103(a) on Arledge 5,437,941 Claims 10-12, 15-43, 51-54, 89-92, 94-97 and 103-109 rejected § 103(a) on ShoKoolie 5,140,696.
<u>Division</u>	7/28/01	Non-elected claims 1-9, 44-50, 55-88, 93 and 98-102 of S.N. 09/037,801 (Docket 7310) placed in a divisional application (S.N. 09/627,959-Docket 7310.D1).
<u>Continuation</u>	8/14/01	Elected Claims placed in a continuation application (S.N. 09/930,539-Docket 7310.C) of S.N. 09/037,801 (Docket 7310).

EXHIBIT "G"

DOCKET 7310.C S.N. 09/930,539

Examiner ALEJANDRO

Application Filed	8/14/01	The elected Claims of S.N. 09/037,801 placed in this continuation. 3/7/00, 8/14/00, 12/15/00 Declaration of Dr. LaFollette filed.
Declaration	12/11/02	Declaration of Dr. LaFollette filed.
Amendment	12/13/02	Amendment before First Action.
Petition	4/08/04	Petition to Make Special.
Petition Granted	5/18/04	Petition to Make Special granted.
Office Action	6/04/04	Restriction 1 Species Requirement even though in parent S.N. 09/930,539 it was determined by the Examiner and the Applicant that Claims 10-43, 51-54, 89-92, 94-97 and 103-109 constituted one invention and after almost three years of additional pendency (6 years all together), the Examiner imposed a contradictory restriction/species election requirement, leaving only Claims 21-40 as elected Claims (20 of 49 Claims)- roughly 40% of the Claims elected and examined in S.N. 09/037,801.
Election	6/02/04	Response to Restriction/Species electing Claims 21-40.
Office Action	8/05/04	Claims 21-31, 33-36 and 38-40 rejected on Bates 5,455,126. Claims 26-28, 32 and 37 rejected under § 103(a) on Bates and Miekka 6,045,942.

After six years of prosecution, about 60% of the elected Claims in parent S.N. 09/037,781 are no longer elected because of an arbitrary restriction and the Examiner has capitulated to the position of the Applicant's as to the four references relied upon in parent S.N. 09/037,781, but now relies for the first time in six years on two new references.

EXHIBIT "H"



US005338625A

United States Patent [19]

Bates et al.

[11] Patent Number: 5,338,625

[45] Date of Patent: Aug. 16, 1994

[54] THIN FILM BATTERY AND METHOD FOR MAKING SAME

[75] Inventors: John B. Bates, Oak Ridge; Nancy J. Dudney, Knoxville; Greg R. Gruzalski, Oak Ridge; Christopher F. Luck, Knoxville, all of Tenn.

[73] Assignee: Martin Marietta Energy Systems, Inc., Oak Ridge, Tenn.

[21] Appl. No.: 921,538

[22] Filed: Jul. 29, 1992

[51] Int. Cl.⁵ H01M 6/18

[52] U.S. Cl. 429/193; 429/127

[58] Field of Search 429/193, 127, 152, 218

[56] References Cited

U.S. PATENT DOCUMENTS

4,878,094 10/1989 Balkanski 357/5

5,085,953 2/1992 Akridge et al. 429/193

OTHER PUBLICATIONS

Preparation of Nitrogen Phosphate Glasses From PON
Phosphorous Oxynitride and Properties, Larbi Boubir;
Inorganic Chemistry Review vol. 23, 1986, p. 343.
Jones, S. D. et al., A Thin Film Solid State Microbat-

tery For Use In Powering Microsensors, MRS Solid
State Ionics Symposium (1991).

Creus, R., et al., The Use of Ionic and Mixed Conduc-
tive Glasses in Microbatteries, Materials and Science
Engineering, B3, 109-112 (1989).

Chemical Abstract 106(16):130547b.

Primary Examiner—José G. Dees

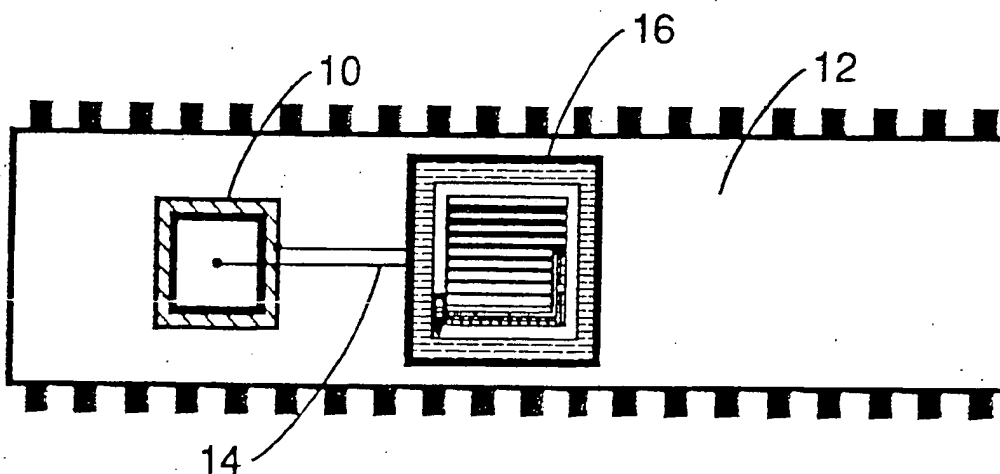
Assistant Examiner—Samuel Barts

Attorney, Agent, or Firm—George L. Craig; J. Donald
Griffin; Harold W. Adams

[57] ABSTRACT

Described is a thin-film battery, especially a thin-film microbattery, and a method for making same having application as a backup or primary integrated power source for electronic devices. The battery includes a novel electrolyte which is electrochemically stable and does not react with the lithium anode and a novel vanadium oxide cathode. Configured as a microbattery, the battery can be fabricated directly onto a semiconductor chip, onto the semiconductor die or onto any portion of the chip carrier. The battery can be fabricated to any specified size or shape to meet the requirements of a particular application. The battery is fabricated of solid state materials and is capable of operation between -15° C. and 150° C.

6 Claims, 5 Drawing Sheets



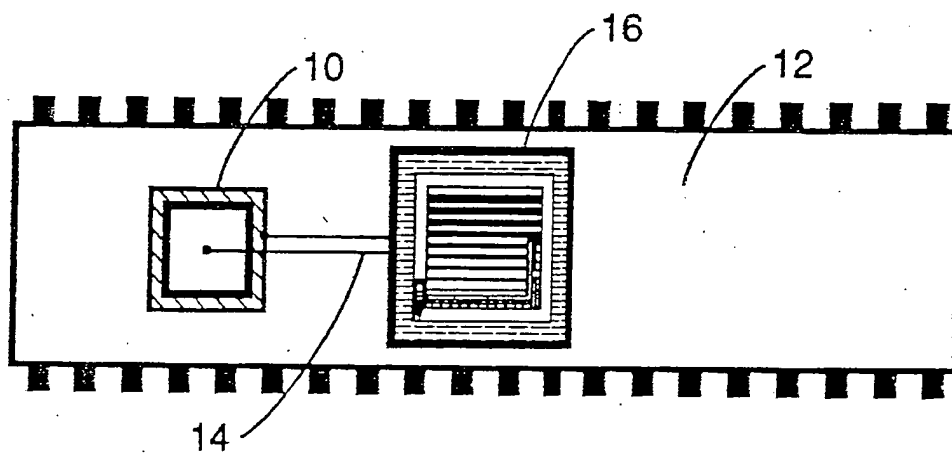


Fig. 1

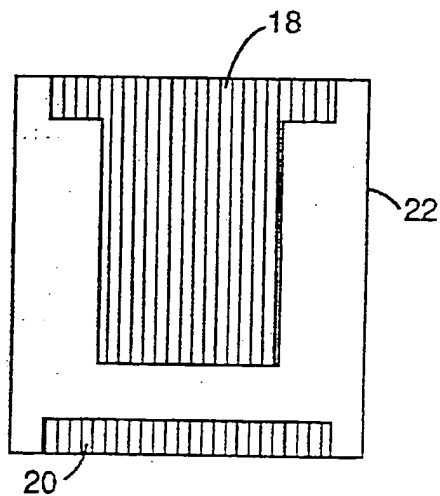


Fig. 2a

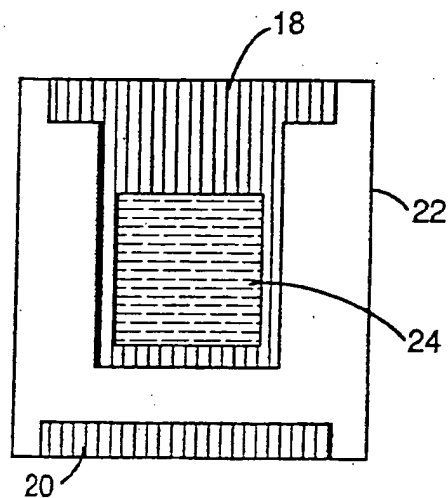


Fig. 2b

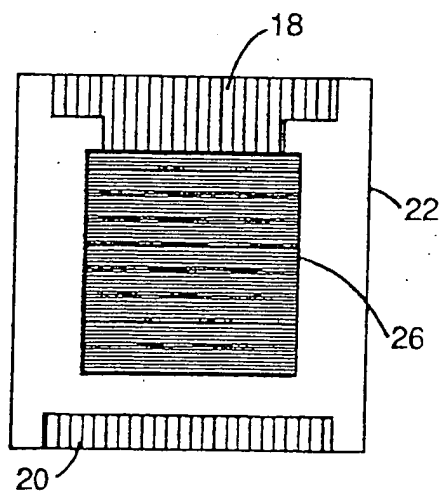


Fig. 2c

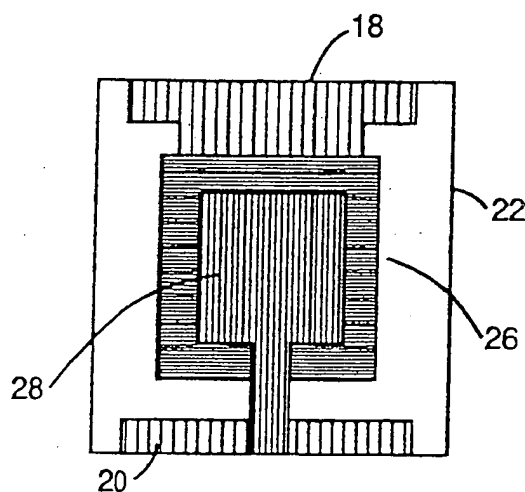


Fig. 2d

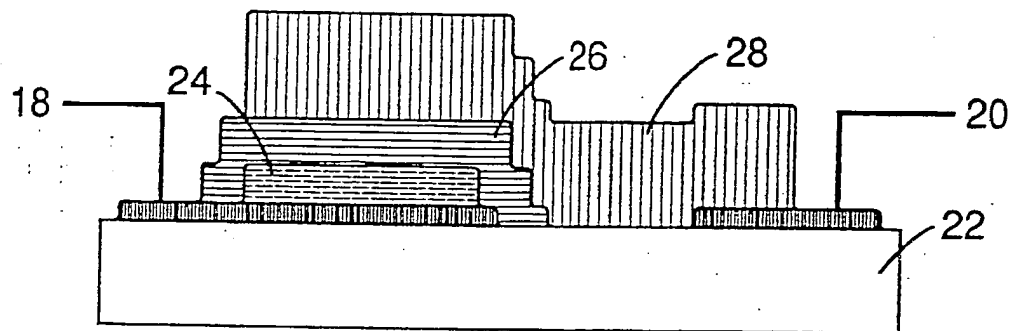


Fig. 3

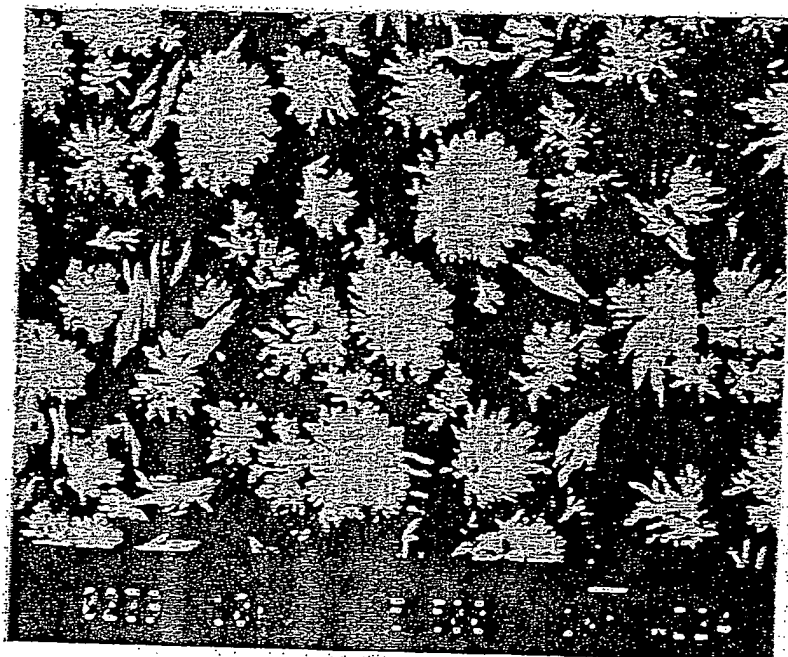


Fig. 4a

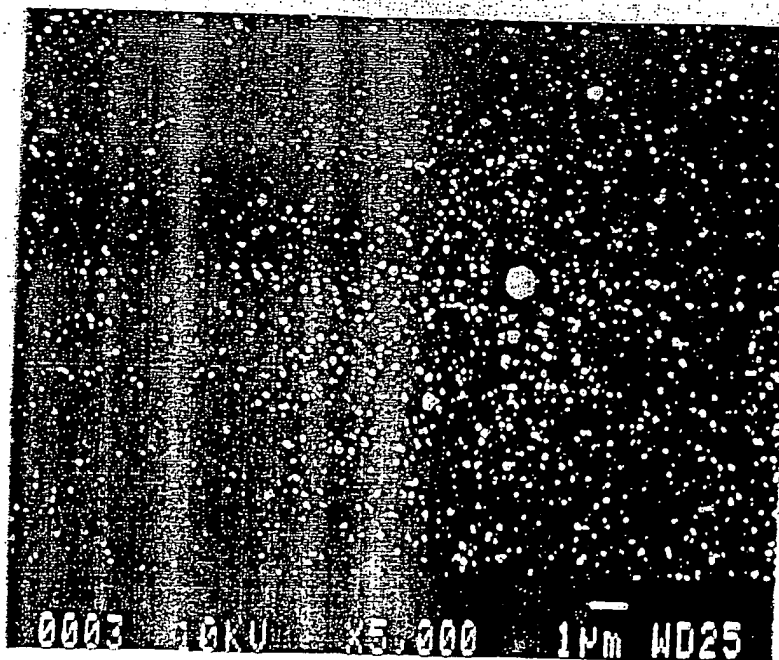


Fig. 4b

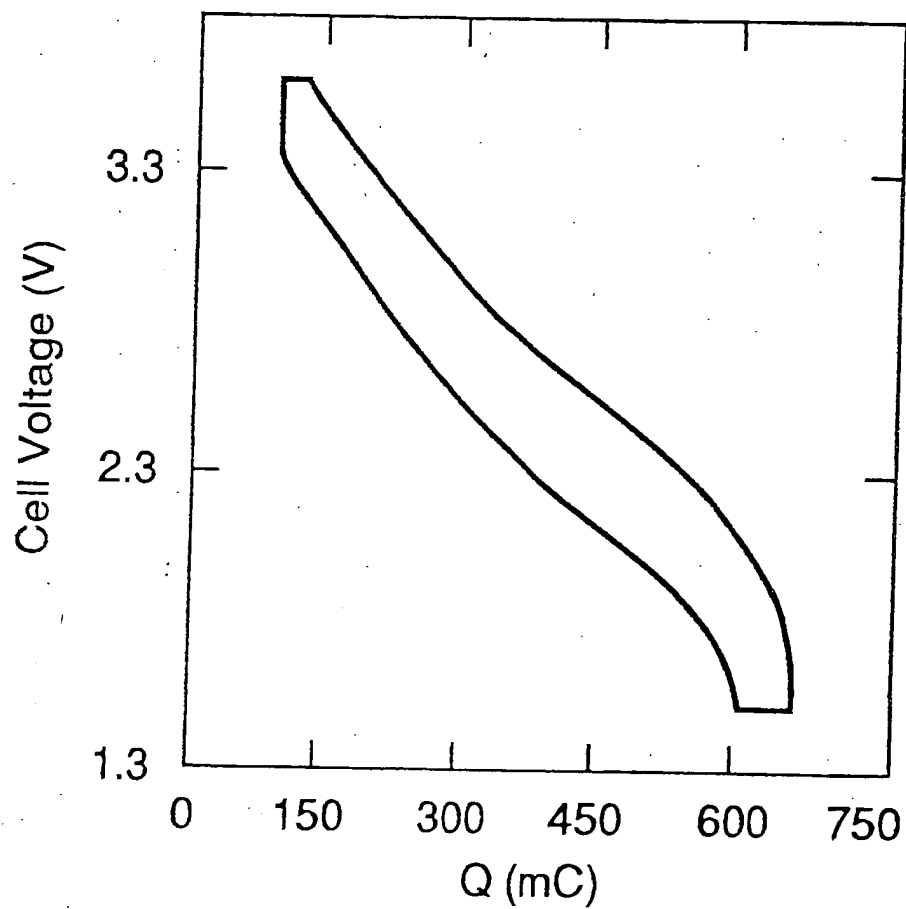


Fig. 5

THIN FILM BATTERY AND METHOD FOR MAKING SAME

This invention was made with Government support under Contract No. DE-AC05-84OR21400 awarded by the U.S. Department of Energy to Martin Marietta Energy Systems, Inc. The Government has certain rights in this invention.

BACKGROUND OF INVENTION

1. Field of Invention

The invention is directed to a thin-film battery and a method for making same. More particularly, the invention is directed to a new thin-film lithium battery having a novel electrolyte permitting a battery to be fabricated having greatly enhanced energy density and specific energy over conventionally available batteries. The invention is also directed to a novel cathode permitting a battery to be fabricated having significantly enhanced energy densities over conventionally available batteries.

2. Description of Prior Art

A battery is one of two kinds of electrochemical devices that convert the energy released in a chemical reaction directly into electrical energy. In a battery, the reactants are stored close together within the battery itself; whereas in a fuel cell the reactants are stored externally. The attractiveness of batteries as an efficient source of power is that the conversion of chemical energy to electrical energy is potentially 100% efficient although the loss due to internal resistance is a major limiting factor. This potential efficiency is considerably greater than the conversion of thermal energy to mechanical energy as used in internal combustion engines, which always results in heat transfer losses. Moreover, the additional disadvantages of contaminants emitted into the atmosphere as byproducts of incomplete combustion and dwindling availability of fuel supplies have intensified research into batteries as an alternative source of energy.

One limitation of conventional batteries is that they use toxic materials such as lead, cadmium, mercury and various acid electrolytes that are facing strict regulation or outright banning as manufacturing materials. Another limitation is that the amount of energy stored and/or delivered by the battery is generally directly related to its size and weight. At one end of the development spectrum, automobile batteries produce large amounts of current but have such low energy densities and specific energies due to their size and weight and such relatively lengthy recharge times that their usage as a source of propulsion is impractical. At the other end of the development spectrum, small, light, lithium batteries used to power small electronic appliances and semiconductor devices have much higher energy densities and specific energies but have not had the capability to be scaled up to provide the high energy for high power applications such as use in automobiles. Further, these small, light, lithium batteries have low charge-discharge cycle capability, limited rechargeability and, even when scaled down for microelectronics applications, size that frequently is many times larger than the semiconductor chip on which they are used.

Thin-film battery technology is foreseen as having several advantages over conventional battery technology in that battery cell components can be prepared as thin, e.g. 1 micron, sheets built up in layers using techniques common to the electronics industry according to

the desired application. The area of the sheets can be varied from sizes achievable with present lithographic techniques to a few square meters providing a wide range in battery capacity. Deposition of thin films places the anode close to the cathode resulting in high current density, high cell efficiency and a great reduction in the amount of reactants used. This is because the transport of ions is easier and faster in thin film layers since the distance the ions must move is lessened.

Most critical to battery performance is the choice of electrolyte. It is known that the principle limitation on rechargeability of prior batteries is failure of the electrolyte. Battery failure after a number of charge-discharge cycles and the loss of charge on standing is caused by reaction between the anode and the electrolyte, e.g. attack of the lithium anode on the lithium electrolyte in lithium batteries. An extra process step of coating the anode with a protective material adds to the complexity, size and cost of the battery.

The power and energy density of a battery is also dependent upon the nature of the cathode. To achieve optimum performance, the open circuit voltage and current density on discharge should be as high as possible, the recharge rate should be high and the battery should be able to withstand many charge-discharge cycles with no degradation of performance. The vanadium oxide cathode of the present invention has a much higher capacity per mole than the crystalline TiS_2 of prior art cathodes.

The present invention avoids the limitations of present battery design and provides a novel battery having application as a battery used with manufacture of semiconductor components and as a high energy, high current macrobattery with appropriate scale-up of the described processes. The present invention includes a novel electrolyte having a good conductivity but more importantly it has electrochemical stability at high cell potentials and requires no protective layer between it and the anode during battery fabrication or use. The present invention also includes a novel cathode having a microstructure providing excellent charge/discharge properties.

SUMMARY OF THE INVENTION

A primary object of invention is to provide a new thin-film battery and a method for making same.

A second object of invention is to provide a new electrolyte for a thin-film battery in which the electrolyte has good ionic conductivity and is not reactive with the battery anode.

Another object of invention is to provide a method for making an improved electrolyte for a thin-film battery.

A yet further object of invention is to provide a new cathode having improved microstructure for a thin-film battery and a method for making same.

These and other objects are achieved by depositing a pair of current collecting films on a substrate; depositing an amorphous cathode layer on the larger of the two collecting films; depositing an amorphous lithium phosphorus oxynitride electrolyte layer over the cathode; and depositing a metallic anode layer over the electrolyte.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic diagram of a thin-film battery deposited onto a semiconductor chip package with current leads extending to a semiconductor chip.

than similarly prepared films containing no nitrogen. The increase in conductivity is due to an increase in lithium ion mobility rather than an increase in the number of charge carriers brought about by a change in the structure of the electrolyte. Further, such cells appear to be stable indefinitely, exhibiting only a small voltage loss which is considered to occur due to the electronic conductivity of the electrolyte.

TABLE I

Comparison of amorphous lithium phosphate, phosphosilicate, and phosphorus oxynitride electrolyte films.				
Target	Process Gas	Film Composition	$\sigma(25^\circ \text{C}) \times 10^6$ (S/cm)	E_2 (eV)
Li_3PO_4	40% O_2 in Ar	$\text{Li}_{2.7}\text{PO}_{3.9}$	7	0.68
$\text{Li}_3\text{PO}_4 + \text{Li}_4\text{SiO}_4$	40% O_2 in Ar	$\text{Li}_{4.4}\text{Si}_{0.23}\text{PO}_{5.2}$	20	0.57
Li_3PO_4	N_2	$\text{Li}_{3.3}\text{PO}_{3.8}\text{N}_{0.22}$	240	0.56

The enhanced conductivity, superior mechanical properties of nitrated glass (e.g. hardness, resistance to fracture) and chemical stability of the oxynitride lithium electrolyte of the present invention could also be used to fabricate enhanced electro-optic devices using electrochromic layers, i.e. so called smart windows, because of the increased resistance to attack from water vapor.

The performance of the lithium microbattery of the present invention is also very dependent on formation of the cathode. Consideration of the microstructure of the cathode is equally as important as consideration of the composition. Typical of prior thin-film batteries is the use cathodes having a characteristic crystalline microstructure. The microstructure is dependent on substrate temperature, extent of the erosion of the target material due to prior sputtering and the pressure and composition of the process gas during deposition. At substrate temperatures of 400°C ., vanadium oxide cathodes, for example, consist of crystalline platelets standing on edge while films deposited onto substrates at about 50°C . consist of clusters of crystalline fibrous bundles. With reference to FIG. 4, two distinct types of microstructure are shown for vanadium oxide films deposited by reactive sputtering of vanadium. When deposited from an eroded target, the cathode films 28 were characterized by a high density of micron-sized fibrous clusters in FIG. 4A of crystalline V_2O_5 . When a fresh target surface is used and the flow rate is increased to about 20 sccm, the microstructure of the cathode 28 has the smooth microstructure shown in FIG. 4B. The advantage achieved with the amorphous structure over the crystalline structure is that at least three times more lithium ions can be inserted into cathode 28 having such amorphous structure, thus resulting in a lithium cell of much higher capacity.

As the sputtering target, e.g. vanadium, ages, the microstructure of the films deposited with higher flow rates gradually evolves to that of the films having fibrous clusters characteristic of deposition at the lower flow rates. This change in the films is evident by a decrease in sputtered target voltage (at constant power) and as much as a 30% decrease in deposition rate.

Lithium cells fabricated with crystalline or amorphous vanadium oxide cathodes had open circuit voltages of 3.6 to 3.7 volts. However, compared with amorphous cathodes, the rates of discharge and charge that the cells with the crystalline cathodes could sustain without excessive polarization are significantly lower, usually less than 3 microAmps per square centimeter. This probably results from poor transport across the interface between the electrolyte 26 and the cathode 28 since the electrolyte 26 does not conformably coat the

fibrous clusters of the crystalline cathode 28 but rather covers just the top portion, resulting in a relatively small contact area.

Lithium cells made according to the present invention having the lithium phosphorus oxynitride electrolyte 26 and the smooth amorphous cathode 28 may be discharged at rates of up to 3 milliAmps per square centimeter. With reference to FIG. 5, a set of charge-discharge curves for one cycle of such a cell is shown. The total charge passed through this cell between 3.64 volts and 1.5 volts is about 575 milliCoulombs. The capacity of the cell over this voltage range is 130 microAmp-hours per square centimeter with an energy density of 1.2×10^6 Joules per kilogram based on combined masses of the cathode, electrolyte and anode.

The greatly enhanced energy density achievable with thin-film batteries made according to the present invention may, with suitable scaling of process parameters, permit fabrication of high energy thin-film macrobatteries. For example, according to the present teachings, a 25-kWh thin-film lithium battery could be constructed by connecting in series approximately 46 large-area thin-film cells. Such a battery would have an average voltage of 165 volts, a weight of 67 kilograms, a volume of 36 liters, a specific energy of 370 Watt-hours per kilogram and an energy density of 690 Watt-hours per liter.

While there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. A thin-film electrochemical cell comprising:

- a substrate;
- a first and a second electrically conductive film deposited on the surface of said substrate, said first and second films separated horizontally and said first film larger than said second film;
- a third film of electrically conductive material deposited over said first film;
- a fourth film of an electrolyte overlapping said third film to extend upon said first film and to partially extend upon said substrate separating said first and second films, said electrolyte having the composition $\text{Li}_x\text{PO}_y\text{N}_z$ where x has an approximate value of 2.8, $2y=3z$ has an approximate value of 7.8 and z has a value between 0.16 and 0.46; and
- a fifth film of electrically conductive and chemically active material deposited over the remainder of said substrate separating said first and second films and over substantially all of said second and said fourth films, said fifth film being electrochemically stable in contact with said fourth film.

2. The cell of claim 1 wherein the substrate material is selected from the group consisting of glass, alumina, semiconductor material and polymer material.

3. The cell of claim 1 wherein the substrate is selected from the group consisting of a semiconductor chip, a semiconductor package and a semiconductor chip carrier.

4. The cell of claim 1 wherein the third conductive material is a metal oxide having an amorphous fine-grain morphology.

5. The cell of claim 4 wherein the diameter of said grain is less than 1 micron.

6. A macroelectrochemical cell comprising a plurality of series connected electrochemical cells made according to claim 1.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 5,338,625

DATED : August 16, 1994

INVENTOR(S) : John B. Bates, Nancy J. Dudney, Greg R. Gruzalski,
Christopher F. Luck

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In Claim 1, column 6, line 46 of the Patent, delete "="
and insert --+-- therefor.

Signed and Sealed this
Twenty-fifth Day of April, 1995

Attest:



BRUCE LEHMAN

Attesting Officer

Commissioner of Patents and Trademarks

EXHIBIT "I"



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/037,801 03/10/98 LAFOLLETTE

R 7310

LYNN G FOSTER
FOSTER & FOSTER
602 EAST 300 SOUTH
SALT LAKE CITY UT 84102

IM22/0220

EXAMINER

ALEJANDRO, R

ART UNIT

PAPER NUMBER

1745

26

DATE MAILED:

02/20/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

RECEIVED
MAR 10 2001
Foster & Foster L.C.

Office Action Summary

Application No.
09/037,801

Applicant(s)
Lafollete et al.

Examiner
Raymond Alejandro

Group Art Unit
1745



☒ Responsive to communication(s) filed on 1/11/01

☐ This action is FINAL.

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 35 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claim

☒ Claim(s) 10-43, 51-54, 89-92, 94-97, and 103-109 is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 10-43, 51-54, 89-92, 94-97, and 103-109 is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☒ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☒ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☒ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

— SEE OFFICE ACTION ON THE FOLLOWING PAGES —

Art Unit: 1745

DETAILED ACTION

Continued Prosecution Application

1. The request filed on 01/11/01 for a Continued Prosecution Application (CPA) under 37 CFR 1.53(d) based on parent Application No. 09/037801 is acceptable and a CPA has been established. An action on the CPA follows.

Specification

2. The amendment filed 01/11/01 is objected to under 35 U.S.C. 132 because it introduces new matter into the disclosure. 35 U.S.C. 132 states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: (claims 10, 33, 41-43, 51, 89 and 94-95) "the footprint substantially less/smaller than 20 cm²" (footprint area); (claims 10, 21, 41-43) "the size-congruent" limitation. As to the footprint size, it is noted that specification (page 15, lines 1-7) clearly encompasses "batteries with a very tiny footprint (area), on the order of 0.1 cm² down to 0.0001 cm²". *Thus, the footprint area as instantly claimed is not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor originally had possession of the claimed invention.* As far as the "congruent-size", it is noted that this terminology has not been disclosed throughout the specification.

Applicant is required to cancel the new matter in the reply to this Office action.

Art Unit: 1745

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 10-43, 51-54, 89-92, 94-97 and 103-109 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The added material which is not supported by the original disclosure is as follows: (claims 10, 33, 41-43, 51, 89 and 94-95) "the footprint substantially less/smaller than 20 cm²" (footprint area); (claims 10, 21, 41-43) "the size-congruent" limitation. As to the footprint size, it is noted that specification (page 15, lines 1-7) clearly encompasses "batteries with a very tiny footprint (area), on the order of 0.1 cm² down to 0.0001 cm²". *Thus, the footprint area as instantly claimed is not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor originally had possession of the claimed invention.* As far as the "congruent-size", it is noted that this terminology has not been disclosed throughout the specification.

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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6. Claims 42-43 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

7. The term "suitable" in claims 42 (line 4) and 43 (line 4) is a relative term which renders the claim indefinite. The term "suitable" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

Claim Rejections - 35 USC § 103

8. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

9. Claims 10-12, 15-43, 51-54, 89-92, 94-97 and 103-109 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arledge et al 5437941.

The instant claims are drawn to a microscopic rechargeable battery wherein the alleged inventive concept comprises the microscopic structures. Other limitations include the thin film, the non-conductive base, the materials, the electrolyte influent flow path, the etched cavity and the separators.

Arledge et al disclose an energy storage device having an electrode consisting of a thin film of metal or metal oxide *deposited on a substrate*. Spherical plastic spacers are uniformly dispersed on the electrode at a maximum density of about 1000 spacers per square millimeter of

Art Unit: 1745

the electrode area. A second substrate also has an electrode formed on it, similar to the first substrate (abstract/ col 2, lines 9-33). The first and second substrate are arranged so that the electrodes face each other and are separated by the spherical plastic spacers to form a gap of about 20 microns between electrodes. An electrolyte is filled in the gap. The device may also be formed by using *metal foils*, and eliminating one or more of the substrates. The use of an electrolyte is optional (abstract/ col 2, lines 9-33). It is related to electrical energy storage devices such as electrochemical cells (col 1, lines 9-10/ col 5, lines 35-44). The total area of the plane between the two electrodes in the cell is approximately 20 square centimeters (col 5, lines 3-6).

Arledge et al disclose that the substrate could be nonconductive but in the case where the substrate is conductive it could also function as a current collector. A thin film of electrode material would be applied to the face of a substrate. The electrode material would be applied to the substrate using standard deposition techniques such as sputtering, evaporation, lamination, plating, chemical vapor deposition or plasma spraying (col 2, lines 34-51).

Arledge et al teach the electrodes are between 0 to about 10,000 Angstroms thick. This is the range of coating thickness that is known to those skilled in the art as a thin film. For example, hybrid microelectronic circuits are made in the range of 100-15,000 Angstroms. However, in some instances the user may wish to deposit a somewhat heavier film of metal or metal oxide, and films up to about 30,000 Angstroms, most preferentially, the film will be between 1000 and 3000 Angstroms thick. *The electrode may be patterned by a number of conventional means, including etching* (col 2, line 52 to col 3, line 2). Examples 1 and 2 illustrate two small

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sheets with about 750 Angstrom and the method to make them. Since the present claims are also directed to a microscopic battery integratable with a microelectronic circuit, it would be capable of being integrated with a microelectronic circuit.

Arledge et al disclose electrical energy storage device according to the foregoing.

However, Arledge et al do not explicitly disclose the integrated battery with a microelectronic circuit and the specific power output.

In view of the above, it would have been obvious to one skilled in the art at the time the invention was made to integrate the microscopic battery with a microelectronic circuit as Arledge et al teaches that microelectronic circuits are made with same thin films, method and characteristics used to product the microscopic thick electrodes. In this regard, this thin film technology is known to those skilled in the art and therefore it would be obvious to have thin film electrodes integrated with a microelectronic circuit deposited on substrate that are held in close proximity and have the capability of producing devices that have very high capacitance per unit volume. This provide a competitive advantage over the conventional art by creating an energy storage device that can store more energy and provide more specific power in a smaller, less complex package than other technologies. Premised on Arledge et al's disclosures, it would be obvious to a skilled artisan to recognize that the dimension of the battery itself is thus totally commensurate to the dimension of the microcircuit or microelectromechanical system, or vice-versa

Art Unit: 1745

10. Claims 10-12 and 15-43, 51-54, 89-92, 94-97 and 103-109 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shokoohi et al 5110696.

Shokoohi et al disclose a rechargeable thin film intercalation electrode battery having a thin film electrode. The battery is assembled directly upon semiconductor devices and integrated circuitry (abstract). It is disclosed that the produced crystalline grain sizes generally larger than about one micrometer which is related to the electrode surface area in typical 0.5 to 1.5 micrometer thin films (col 2, lines 12-17). The thin film electrode for secondary batteries is made under conditions that are compatible with microelectronics technology (col 2, lines 19-24). The thin film layer is deposited by reactive electrode beam evaporation onto a suitable substrate from a bulk source of the oxide compound; it is obtained a 0.05 to 0.1 micrometer grain size (col 2, lines 30-36/ col 2, lines 50-51). The crystalline substrate is coated with the thin film layer in any evaporative or sputtering technique to provide such a buffer layer upon which the electrode compound condenses during the evaporative coating operation (col 2, lines 41-45/col 4, lines 55-59). It is disclosed a substrate of about 10 mm diameter (col 5, lines 50-55).

Shokoohi et al disclose an electrode structure consisting essentially of a substrate, an inert buffer layer, and thin film layer of the active compound (col 4, lines 26-30). The substrate could comprise GaAs, Si or other semiconductor device material, in ultimate use with integrated microelectronic circuitry (col 4, lines 39-42). The insulating layer and a metallic buffer layer are also disclosed (col 4, lines 42-47). A thin film layer of about 10 nm is useful to ensure effective bonding (col 4, lines 52-54).

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Shokoohi et al teach that substrate does not react with the electrode compound due to the use of influential substrates such as quartz, s/s, or aluminum. Also, it is disclosed the masking of physical imperfections that might nucleate larger crystal growth (col 2, lines 52-59). *Masking as etching produces or adjust patterns or designs on the surface of the electrode substrate.* The method of electrode preparation is disclosed (col 2, lines 60-68) including the deposition of film on the substrate until the desired film thickness (col 3, lines 10-12). The electrolyte as well as the anode elements are taught; also the method may be employed for anodes (col 3, lines 24-30/col 3, lines 52-55). By using this method, the electrode compounds may be used in integration of power supplies with microelectronic circuitry (col 4, lines 1-5).

Shokoohi et al further teach that the cell comprises a body fitting in which are assembled insulating material and the active cell elements consisting of the cathode, the anode and the intermediate separator of glass cloth (non-metallic) and a solution (col 6, lines 41-56). It is further disclosed the cell performance was tested over series of charge/discharge cycles at varying current densities as shown in Figure 3 (col 6, line 58 to col 7, line 10).

Shokoohi et al disclose a battery according to the aforementioned aspects. However, Shokoohi et al do not explicitly disclose the footprint area and the specific power output.

In view of this disclosure, it would be obvious to make a battery having an area on a surface covered (footprint area) by the cell assembly of less than 20 cm² as Shokoohi et al teaches that in a fabrication of an exemplary film electrode the diameter of the substrate is about 10 mm which is approximately equivalent to an area of 0.785 cm². Since the anode may be substantially

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the same in size as the cathode; the electrodes gap is commensurate to the electrode size and the body fitting in which the components are assembled simply provides a suitable enclosure for the cell, the size of the cell is substantially less than 20 cm^2 . Accordingly, the volume required to store the energy is determined by the specific power requirements of the cell. However, if the cells are made of sufficient size, enough energy can be stored to produce a specific charge, energy and/or power output.

11. Claims 13-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arledge et al 5437941 as applied to claim 10 above, and further in view of Wrighton et al 4717673.

Arledge et al is applied and incorporated herein for the reasons above. In addition, Arledge et al do not disclose the sensor system.

Wrighton et al disclose a polymer based electrochemical device which functions as a sensitive sensor which measures changes in chemical concentration or pH (col 1, lines 32-35); the polymer based microelectronic device amplify very small electrical or chemical signals (col 1, lines 36-39). The device can be incorporated into microelectronic systems and conventional integrated circuitry which are responsive to electrical input (col 1, lines 49-51). The device is useful as car battery (col 2, lines 41-43).

In view of the above, it would have been obvious to one skilled in the art at the time the invention was made to integrate the sensor system of Wrighton et al in the energy storage device of Arledge et al as Wrighton et al disclose that the device can be incorporated into

Art Unit: 1745

microelectronic systems and conventional integrated circuitry which are responsive to electrical input. Thus, the microelectronic device may provide very high resolution, stability and rapid response of battery conditions such as changes in chemical concentration e.g. pH, hydrogen, oxygen, and other chemicals.

Response to Arguments

12. Applicant's arguments filed 01/11/01 have been fully considered but they are not persuasive. The contention of applicant arguments' is based on the reasons set forth by the applicant in declarations filed 08/18/00 and 12/15/00. Hence, the declarations have also been fully considered, however they are not convincing so as to overcome the rejection over Arledge et al. The declaration presents many reasons regarding the capacitive behavior of energy storage devices, integratable microcircuits and whether or not the disclosure of Arledge et al enables fabrication of batteries; and cell sizes and capacities.

The assertion that the prior art enables only capacitor and does not relate to microscopic sized batteries or does not pertain to batteries is not sufficient to overcome the rejection. First, it is pointed out that the '941 patent clearly disclose/teach/enable electrochemical cells (col 1, lines 8-10). Moreover, the reference teaches that while the behavior exhibited with these examples is capacitive in nature, by employing different electrode materials, an electrochemical cell, such as a battery can be created (col 5, lines 35-45). Thus, a skilled artisan would recognize that the battery of the prior art must also be used similarly to the microscopic

Art Unit: 1745

battery of the instant claims. Furthermore, even though the reference do not explicitly state the use of a microscopic battery, it is an implicit teaching. In that, the battery of the prior art may be made as the microscopic battery of the instant claims. In this regard, a reference is good not only for what it teaches by direct anticipation but also for what one of ordinary skill might reasonably infer from the teachings. Also, it is not necessary that the prior art suggest expressly or in so many words, the changes or possible improvements the invention intends. It is only necessary that the reference apply the general knowledge clearly present in the prior art.

As to the footprint area, it is noted that both references disclose batteries comprising microcomponents and microcircuitry, since the size of the electrode elements are commensurate to the battery size and the body fitting in which the components are assembled simply provides a suitable enclosure for the cell, the size of the cell is somewhat equal in measure or extent of the components so as to correspond in size, or structural proportion. Thus, the skilled artisan would recognize that the dimension of the battery itself is thus totally commensurate to the dimension of the microcomponents placed inside the battery.

In response to applicant's argument that reference enables only capacitors and it briefly mentions batteries, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Art Unit: 1745

Applicant's arguments do not comply with 37 CFR 1.111© because they do not clearly point out the patentable novelty which he or she thinks the claims present in view of the state of the art disclosed by the references cited or the objections made. Further, they do not show how the amendments avoid such references or objections.

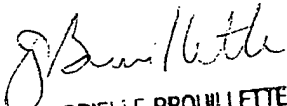
Conclusion

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Raymond Alejandro whose telephone number is (703) 306-3326. The examiner can normally be reached from Monday- Thursday from 8:00 am to 6:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gabrielle Brouillette, can be reached at (703) 308-0756.

In order to transmit an unofficial fax, the number is (703) 306-3429. In order to transmit an official fax/amendments after final, the number is (703) 305-3599.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0661.


GABRIELLE BROUILLETTE
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700

Notice of References Cited

Application No.
09/037,801

Applicant(s)

Lafollete et al.

Examiner
Raymond Alejandro

Group Art Unit
1745

Page 1 of 1

U.S. PATENT DOCUMENTS

	DOCUMENT NO.	DATE	NAME	CLASS	SUBCLASS
A	5,110,696	5/1992	Shokoohi et al	429	218
B	4,717,673	5/1992	Wrighton et al	436	68
C					
D					
E					
F					
G					
H					
I					
J					
K					
L					
M					

FOREIGN PATENT DOCUMENTS

	DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS	SUBCLASS
N						
O						
P						
Q						
R						
S						
T						

NON-PATENT DOCUMENTS

	DOCUMENT (Including Author, Title, Source, and Pertinent Pages)	DATE
U		
V		
W		
X		

EXHIBIT "J"



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

MF

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/037,801 03/10/98 LAFOLLETTE

R 7310

LYNN G FOSTER
FOSTER & FOSTER
602 EAST 300 SOUTH
SALT LAKE CITY UT 84102

IM22/0909

EXAMINER

ALEJANDRO, R

ART UNIT	PAPER NUMBER
----------	--------------

1745

DATE MAILED:

09/09/99

7

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

RECEIVED
SEP 14 1999
Foster & Foster L.C.

Office Action Summary

Application No.
09/037,801

Applicant(s)
Lafollete et al.

Examiner
Raymond Alejandro

Group Art Unit
1745



- ☐ Responsive to communication(s) filed on _____
- ☐ This action is **FINAL**.
- ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 1 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

- ☒ Claim(s) 1-102 is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

- ☐ Claim(s) _____ is/are allowed.

- ☐ Claim(s) _____ is/are rejected.

- ☐ Claim(s) _____ is/are objected to.

- ☒ Claims 1-102 are subject to restriction or election requirement.

Application Papers

- ☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.
- ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
- ☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.
- ☐ The specification is objected to by the Examiner.
- ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).
- ☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been
- ☐ received.
- ☐ received in Application No. (Series Code/Serial Number) _____
- ☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

- ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

- ☐ Notice of References Cited, PTO-892
- ☐ Information Disclosure Statement(s), PTO-1449, Paper No(s) _____
- ☐ Interview Summary, PTO-413
- ☐ Notice of Draftsperson's Patent Drawing Review, PTO-948
- ☐ Notice of Informal Patent Application, PTO-152

Art Unit: 1745

DETAILED ACTION

Election/Restriction

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claim 1, drawn to a microelectro-mechanical system and a source of electrical energy, classified in class 429, subclass 122.
 - II. Claims 2, 75 and 77, drawn to a microelectro-mechanical system and a microscopic battery, classified in class 429, subclass 122.
 - III. Claim 3, drawn to a microelectronic circuit and a microscopic battery, classified in class 429, subclass 122.
 - IV. Claims 4-9, drawn to a microelectronic circuit and a microscopic battery, classified in class 429, subclass 122.
 - V. Claims 10-20 and 76, drawn to a microscopic circuit, a microelectro-mechanical system and an aqueous microscopic battery, classified in class 429, subclass 122.
 - VI. Claims 21-32, drawn to a microscopic rechargeable battery comprising etched spaced electrodes, classified in class 429, subclass 128.
 - VII. Claims 33-40, drawn to a microscopic rechargeable battery comprising separated microscopic electrodes, classified in class 429, subclass 209.
 - VIII. Claim 41, drawn to a method, classified in class 29, subclass 623.1.
 - IX. Claim 42, drawn to a method, classified in class 29, subclass 623.1.

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- X. Claim 43, drawn to a method, classified in class 29, subclass 623.1.
- XI. Claims 44-50, drawn to a method, classified in class 29, subclass 623.1.
- XII. Claims 51-54, drawn to a method of making a microscopic battery, classified in class 29, subclass 623.1.
- XIII. Claims 55-63, drawn to a method of making a microscopic battery, classified in class 29, subclass 623.1.
- XIV. Claim 64, drawn to a microscopic battery comprising a thin microscopic rod-shaped electrode, classified in class 429, subclass 128.
- XV. Claims 65-69, 82 and 93, drawn to a multicell rechargeable microscopic battery, classified in class 429, subclass 149.
- XVI. Claims 70-73, 81, 83-85 and 88-92 and 94, drawn to a microscopic conformal microscopic battery comprising an electrolyte, classified in class 429, subclass 126.
- XVII. Claim 74, drawn to a microelectro-mechanical system and a rechargeable microscopic battery, classified in class 429, subclass 122.
- XVIII. Claim 78-80, drawn to an integrated microelectronics system, classified in class 429, subclass 122.
- XIX. Claim 86, drawn to a microscopic battery comprising spaced concentric electrodes, classified in class 429, subclass 209.
- XX. Claim 87, drawn to a method of making a microscopic battery, classified in class 29, subclass 623.1.

Art Unit: 1745

XXI. Claim 95-97, drawn to a method of making a microscopic battery, classified in class 29, subclass 623.1.

XXII. Claim 98-100, drawn to a method of confirming the size of a microscopic battery feature, classified in class 29, subclass 623.1.

XXIII. Claim 101-102, drawn to a method of unitarily fabricating an integrated circuit and microscopic battery, classified in class 29, subclass 623.1.

2. Inventions A (including the following groups VIII to XIII and XX to XXIII) and B (including the following groups I to VII and XIV to XIX) are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case that the product as claimed can be made by another and materially different process for example the battery could be made along with the MEMS of the microcircuit.

Thus, applicant must elect one of the above groups or the applicant may elect one of the species below.

EXHIBIT "K"



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/037,801	03/10/98	LAFOLLETTE	R 7310

LYNN B FOSTER
FOSTER & FOSTER
602 EAST 300 SOUTH
SALT LAKE CITY UT 84102

IM62/0220

EXAMINER
ALEJANDRO, R

ART UNIT	PAPER NUMBER
1745	12

DATE MAILED: 02/23/00

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

RECEIVED

FEB 25 2000

Foster & Foster L.C.

Office Action Summary

Application No.

09/037,801

Applicant(s)

Lafollete et al.

Examiner

Raymond Alejandro

Group Art Unit

1745



☒ Responsive to communication(s) filed on 12/16/99

☐ This action is FINAL.

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle* 35 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claim

☒ Claim(s) 1-102 is/are pending in the application

Of the above, claim(s) 1-9, 44-50, 55-88, 93, and 98-102 is/are withdrawn from consideration

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 10-43, 51-54, 89-92, and 94-97 is/are rejected.

☐ Claim(s) _____ is/are objected to.

☒ Claims 1-102 are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☒ The drawing(s) filed on 3/10/98 is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☒ The specification is objected to by the Examiner.

☒ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☒ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☒ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☒ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☒ Notice of Informal Patent Application, PTO-152

— SEE OFFICE ACTION ON THE FOLLOWING PAGES —

Interview Summary

Application No.
09/037,801

Applicant(s)
Lafollette

Examiner
Maria Nuzzolillo

Group Art Unit
1745



All participants (applicant, applicant's representative, PTO personnel):

(1) Maria Nuzzolillo (3) _____

(2) Mr. Lynn Foster (4) _____

Date of Interview Feb 3, 2000

Type: ☒ Telephonic ☐ Personal (copy is given to ☐ applicant ☐ applicant's representative).

Exhibit shown or demonstration conducted: ☐ Yes ☒ No. If yes, brief description:

Agreement ☒ was reached. ☐ was not reached.

Claim(s) discussed: Claims of proposed group, i.e. 10-43; 51-55; 78; 80-88; 94-105

Identification of prior art discussed:

Description of the general nature of what was agreed to if an agreement was reached, or any other comments:

Agreement was reached to examine elected claims of newly proposed Group I. Thus, the examiner will examine on the merits claims 10-43; 51-54; 89-92 and 94-97.

(A fuller description, if necessary, and a copy of the amendments, if available, which the examiner agreed would render the claims allowable must be attached. Also, where no copy of the amendments which would render the claims allowable is available, a summary thereof must be attached.)

1. ☐ It is not necessary for applicant to provide a separate record of the substance of the interview.

Unless the paragraph above has been checked to indicate to the contrary, A FORMAL WRITTEN RESPONSE TO THE LAST OFFICE ACTION IS NOT WAIVED AND MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a response to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW.

2. ☐ Since the Examiner's interview summary above (including any attachments) reflects a complete response to each of the objections, rejections and requirements that may be present in the last Office action, and since the claims are now allowable, this completed form is considered to fulfill the response requirements of the last Office action. Applicant is not relieved from providing a separate record of the interview unless box 1 above is also checked.

Supervisory Patent Examiner
Technology Center 1700

Examiner Note: You must sign and stamp this form unless it is an attachment to a signed Office action.

Art Unit: 1745

DETAILED ACTION

Election/Restriction

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1-9, 75-77 and 79, drawn to a source of electrical energy having a MEMS, classified in class 429, subclass 7.
 - II. Claims 10-43, 51-54, 89-92 and 94-97, drawn to a microscopic battery integrated with a microelectronic circuit, classified in class 429, subclass 122.
 - III. Claims 44-50, 56-69 and 93, drawn to a method for fabricating a microscopic battery, classified in class 29, subclass 623.1.
 - IV. Claims 55, 78, 80-88 and 98-105, drawn to a method of making a microscopic battery forming several microscopic cells, classified in class 29, subclass 623.1.
 - V. Claims 70-74 and 89-92, drawn to a microscopic conformal microscopic battery, classified in class 429, subclass 126.

2. The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are unrelated. Inventions are unrelated if it can be shown that they are not disclosed as capable of use together and they have different modes of operation, different functions, or different effects (MPEP § 806.04, MPEP § 808.01). In the instant case the different inventions have different modes of operation, different functions, or different effects.

3. Inventions III and I are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be

EXHIBIT "L"

Fundamentals of **MICROFABRICATION**

Marc Madou



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Integrated Power

As in the case of portable computers, small, light-weight and long lasting energy sources are one of the most urgently needed breakthrough technologies. Microsystems require even smaller power sources, as weight and volume of on-board energy sources are disproportionately large compared to the microsystems they power. The roles of energy storage and energy dissipation in microsystems differ considerably from the world of practical daily experience. Designing microsystems demands close examination of energy budgets and taking advantage of the merits of smallness as well as minimizing its adverse effects.¹²⁷

The specific energy (energy per volume unit) of the power source determines the proper active volume for a given application. If the volume of the packaging is taken into account, energy volume densities of lithium batteries may reach 240 to 360 Wh/l. These lithium-based batteries generate the highest specific energy of any commercially available battery. In these batteries the anode, consisting of high purity lithium, may be combined with many different cathode materials, resulting in different voltages ranging from 1.5 to 3.9 V. Organic solvents in which lithium salts are dissolved and conducting solid polymers function as electrolytes. Beyond button Li batteries 4.8 mm (dia.) by 1.4 mm (high) used in watches and cameras, progress in miniaturizing high-energy density power sources has been limited. Button Li cells are now the best available energy sources for microsystems. Batteries and fuel cell materials deposited with IC technologies on the device substrate itself are in the research stage.¹²⁸ Often the thin film materials deposited in constructing those batteries, such as Li, TiS_2 , V_2O_5 , etc. prove incompatible with the IC process, and the prospect of integrating them with ICs seems remote. Ultrathin, solid state Li cells, 'energy paper', also start to emerge. Kanebo introduced the polymeric PAS (poly-acenic semiconductor)-based battery in 1993. The polymer PAS film in the battery is only 200 μm thick and has an active surface area of 2200 m^2/g . It serves as the anode and the cathode is again lithium based. The voltage is 3.3 V, corresponding to 3 Ni-Cd elements in series. Unfortunately, the energy density, taking the complete, packaged battery into account, is only 5.5 Wh/L.¹²⁷ The reversibility, absence of polarity, and extended lifetime of supercapacitors make them an attractive alternative for power in microsystems. Supercapacitors with energy densities of 1.9 Wh/L and slightly higher are available. In supercapacitors an electrical double layer on a very high surface area material such as activated carbon or IrO_x is reversibly charged and discharged. Since it is possible to carbonize photoresist materials, make them porous, and charge them, it seems feasible that ultracapacitors could be integrated on ICs. The overwhelming issue to overcome, just as in the case of a chemical sensor, is packaging. Supercapacitors and batteries incorporate very corrosive and reactive materials, making the challenge even more daunting. All of the above tend to suggest a hybrid implementation as the only possible means of integrating supercapacitors or thin-film batteries with ICs.

Power generation by the alternate heating and cooling of a working fluid or a solid (e.g., shape memory alloys) integrated

on a chip has been attempted for driving a load. The heating in such an engine results from passing a current through a resistor. It would be preferable though to use infrared radiation instead, since no leads need to connect to the chip. It has been projected that a gas-based heat engine of $5 \times 5 \times 5 \text{ mm}^3$ might provide an output of 10 to 100 W/kg. With actuators based on shape memory alloys, an output of up to 1 kW/kg is feasible, with an efficiency ten times lower.¹²⁷ Several problems are associated with crafting MEMS engines, including the thermal isolation of heating and cooling sections, minimization of friction, and the difficulty of implementing a flywheel. Some of these problems were successfully addressed by Sniegowski et al.^{129,130} who demonstrated a surface micromachined microengine capable of delivering torque to a micromechanism. Angular velocities of 600,000 rpm were registered for the engine driven by an electrostatically comb drive. In an alternative construct, the same engine was also driven by steam.

Given the size of power sources, generating electricity on board or supplying energy from the outside often is preferred. One interesting way to accomplish this, used for several decades in wristwatches, is to use a microgenerator. An eccentrically rotating mass driven by wrist movements supplies energy to a spring. A mechanical watch requires 1 to 2 μW . In order to keep the watch working for 48 hours after it has been removed from the wrist, the loaded spring must contain 4.8 10^{-5} Wh. Given the size of the microgenerator, the system stores about 0.3 Wh/L, more than two orders of magnitude smaller than the specific energy of a button cell for quartz watches. In an automatic quartz watch, the microgenerator drives an electric generator, the electrical energy is then stored in a supercapacitor powering the quartz oscillator, IC, and stepping motor of the watch. The power requirement of a high-quality analog watch is as low as 0.5 μW .¹²⁷ As Goemans points out, the possibility of converting motion into electrical energy can be very attractive for cases where battery replacement is unacceptable, kinetic energy is abundantly available, and space is not too limited. He lists biomedical implants, tire pressure monitoring systems, and electronic locks as potential application areas.¹²⁷

Thermo-electric converters may extract energy in applications where heat and temperature difference are available 'for free'. Thin-film thermocouples have been used to power a watch based on the temperature difference between the cool front face of the watch and the warm skin contact. A disadvantage of this approach is the very low efficiency of the conversion.

We already discussed the implementation of a high-voltage, integrated solar cell array by Lee et al.¹³¹ as an electrostatic MEMS power supply (see Chapter 5). The conversion efficiency in that effort was only 0.2% though. Sakakibara et al.¹³² were able to generate more than 200 V with a similar solar cell on an area of 1 cm^2 and obtained a conversion efficiency of 4.65%. In both cases amorphous silicon was used in a triple-stacked photovoltaic structure generating up to 2.3 V per cell. To obtain a very dense packing of array elements and to make the series connection of the solar cells, the latter group used focused laser beams for patterning electrodes and photovoltaic materials. For future thin-film photovoltaic cells, efficiencies of over 30% are expected. Solar cell technology represents the most MEMS-compatible

technology for power integration. Since solar light is only intermittently available, electric storage elements need be implemented as well. Along this line Kimura et al.¹³ fabricated a miniature opto-electric transformer consisting of a p-n junction photocell and a multilayer spiral coil transformer. Besides photovoltaic converters for solar light and laser light, microwaves could be used to power microsystems. In the latter case, extremely small receivers and converters would need to be built.

For URLs on scaling, actuators, and power sources, see Appendix B.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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01/15/2003

Lynn G Foster
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EXAMINER

ALEJANDRO, RAYMOND

ART UNIT

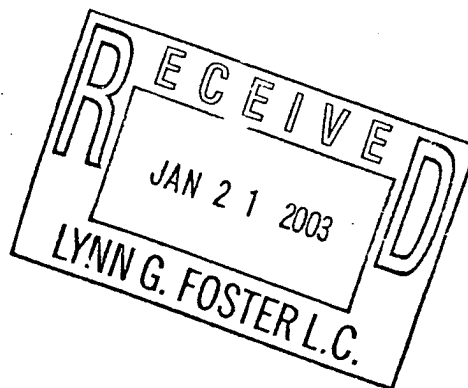
PAPER NUMBER

1745

DATE MAILED: 01/15/2003

14

Please find below and/or attached an Office communication concerning this application or proceeding.



Office Action Summary

Application No.

09/627,959

Applicant(s)

LAFOLLETTE ET AL.

Examiner

Raymond Alejandro

Art Unit

1745

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12/02/09, 12/09/02, 12/17/02.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 103-121 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 110 is/are allowed.
- 6) ☒ Claim(s) 103-109 and 111-121 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

A191

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DETAILED ACTION

Response to Amendment

This communication is responsive to the amendments filed on 12/11/02 and 12/20/02 and all of the declarations (4 papers) submitted along with the amendments. The applicants have overcome the 35 USC 112 rejections and the art rejections as all originally submitted claims have been cancelled. However, the newly submitted claims are finally rejected over art as seen below.

Election/Restrictions

1. Applicant's cancellation of all non-elected claims (claims 1-9, 44-50, 55-77; 79 and 93) in Paper No. 8 and 12 is acknowledged.

Claim Objections

2. Claims 112-114 are objected to because of the following informalities: the capital letters of the dimension unit "CM²" should be changed to "cm²". Appropriate correction is required.
3. Claims 116 is objected to because of the following informalities: the recitation "electrolyte materially" should be changed to "electrolyte material". Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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5. Claims 103-109, 111-112, 119-120 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

6. The language "a non-microelectromechanical system of a microsize congruent with the microsize of the microelectromechanical system" in claim 103 and "microelectronic systems without a microelectromechanical component but having a microsize congruent with the size of an electronic system" in claim 108 is unclear, thereby rendering the claims indefinite. Further, the foregoing language is not defined by the claim, and the specification does not provide a standard for ascertaining the requisite degree. It is unclear why if the microscopic system is a (*or without*) *non-microelectromechanical system*, it is required to make said *non-microelectromechanical system* having a size congruent with the microsize of the microelectromechanical system. Such limitation appears to amount a gap between the necessary structural connections therebetween because it is making reference to an *absent* element which is not part, incorporated or included in the system per se. Further clarification is required.

7. The term "congruent" in claims 103 (two occurrences) and 108 is a relative term which renders the claim indefinite. The term "congruent" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. The specific congruency degree or magnitude of the size is not defined or specified.

8. The language "size compatibility" in claim 103 is indefinite. The term "compatibility" is not defined by the claim, and the specification does not provide a standard for ascertaining the

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requisite degree. The specific compatibility degree or magnitude of the size is not set forth so as to clearly define the particular structural relationship between the elements.

9. Claims 108, 109 and 111 recite the limitation "the microfabricated battery" in lines 7-8 (two occurrences). There is insufficient antecedent basis for this limitation in the claim.

10. The term "an internal macroscopic battery" in claim 108 is unclear and ambiguous, thereby rendering the claim indefinite. Further, the term "macroscopic" is not defined by the claim, and the specification does not provide a standard for ascertaining the requisite degree. It is unclear how the macroscopic battery is to be fitted or incorporated into the microscopic electronic system, that is, the instant claims is intended to recite a micro-system configuration but it also appears that a macro-component is to be included or incorporated in said micro-system configuration.

11. The term "low power loss characteristics" in claim 112 is still considered to be a relative term which renders the claim indefinite. The term "low power loss characteristics" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. The particular degree or magnitude of the limitation "low power loss characteristics" is uncertain.

12. Claim 119 recites the limitation "the elements" in line 1. There is insufficient antecedent basis for this limitation in the claim.

13. The language "while correspondingly integratively microfabricating the integrated circuit at the same site" in claim 120 is of uncertain meaning, thereby rendering the claim vague and indefinite. Further, the preceding language is not defined by the claim, and the specification

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does not provide a standard for ascertaining the requisite degree. It is unclear over what specific site or location, i.e. the first electrode layer, the separator layer, the second electrode layer or battery itself, the integrated circuit is to be fabricated. Furthermore, it is not clear what would be the structural relationship of all elements together.

14. Claim 120 recites the limitation "the integrated microcircuit" in line 6. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 103-109 and 111-121 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bates et al 5455126.

The instant claims are directed to an integrated microelectronic system comprising a microscopic battery as well as methods of making the microscopic battery.

Regarding claims 103, 105, 108, 109, 111, 117-118, 120:

Bates et al disclose a thin-film micro-battery, and a method for making same having applications as a primary integrated power source of electronic devices (ABSTRACT/col 2, lines 64-65). Configured as a microbattery, the battery can be fabricated directly onto a semiconductor chip, onto the semiconductor die or onto any portion of the chip carrier. The battery is fabricated

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of solid state materials (ABSTRACT). It is further disclosed that the batteries can be scaled down for microelectronics applications, a size that frequently is many times larger than the semiconductor chip on which they are used (col 2, lines 9-11). Bates et al further disclose that a battery is one of two kinds of electrochemical devices that convert the energy released in chemical reaction directly into electrical energy (col 1, lines 40-43).

The steps in fabricating the single cell is disclosed: two current collectors are deposited as a larger and a smaller 0.5 micron thick film, on a substrate such as glass. The films may be deposited by sputtering or other film deposition technique common to the semiconductor electronic industry (col 3, lines 50-58). Similarly, a cathode is deposited as a 1 micron thick film over the larger current collector; an electrolyte film is then deposited over the cathode (col 3, lines 60-67); the electrolyte film has a thickness of 1 micron (col 4, lines 5-7); then, a deposition of a film (anode) over the electrolyte film the intervening substrate and the smaller current collector completes the cell. A typical film thickness for the lithium film is about 5 micron (col 4, lines 10-16).

Bates et al teach that the battery can be fabricated to any specified size or shape to meet the requirements of a particular application (ABSTRACT). If a larger battery were deposited over the unused area of the package, the capacity and current density of the battery could be increased (col 3, lines 45-48). It is also disclosed that the performance of thin-film batteries is critically limited by the properties of the chosen electrolyte (col 4, lines 33-37) as well as the performance of the microbattery is also very dependent on formation of the cathode (col 5, lines 30-35).

It is also disclosed that the battery cell components can be prepared as thin sheets built up in layers using techniques common to the electronics industry according to the desired application. Further, the area of the sheets can be varied from sizes achievable with present lithographic techniques to a few square meters providing a wide range in battery capacity. Moreover, deposition of thin films places the anode close to the cathode resulting in high current density, high cell efficiency and a great reduction in the amount of reactants used (col 2, lines 14-25).

As to claims 103 (partly), 104, 106-107, 108 (partly), 111 (partly):

As to the method limitation in the foregoing product claims, i.e. microdepositions of material and selective removal of sacrificial material including microlithography, the microfabrication of both elements occurring together, microfabrication techniques comprising deposition of microscopically thin material, sacrificial removal of some of the microscopically thin material and etching, it is noted that a method limitation incorporated into a product claim does not patentably distinguish the product because what is given patentable consideration is the product itself and not the manner in which the product was made. Therefore, the patentability of a product is independent of how it was made.

With respect to claims 112-114, 121:

Bates et al disclose a cell about 8 microns thick occupying an area of 1 sq-cm has a capacity of 130 micro-AMP-hours and could supply a current of up to 100 microAMPS (col 3, lines 40-45). The capacity of the cell over this voltage range is 130 microAMP-hours per square centimeter with an energy density of 1.2×10^6 J/kg based on the combined masses of the cathode, the anode and the electrolyte (col 6, lines 20-24). It is further taught that a 25 kWh thin

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film battery could be also constructed such a battery would have a specific energy of 370 W-hour/kg and an energy density of 690 W-hours/L (col 6, lines 29-36).

As far as claim 115:

It is disclosed that similarly, a cathode is deposited as a 1 micron thick film over the larger current collector; an electrolyte film is then deposited over the cathode (col 3, lines 60-67); the electrolyte film has a thickness of 1 micron (col 4, lines 5-7); then, a deposition of a film (anode) over the electrolyte film the intervening substrate and the smaller current collector completes the cell (col 4, lines 10-16).

Regarding claim 119:

It is disclosed the steps of deposition of current collectors as smaller as 0.5 micron thick film, on a substrate such as glass (col 3, lines 50-58). At least, one element does posses this measurement.

Bates et al is applied and incorporated herein for the reasons above. In addition, Bates et al do not expressly disclose the microelectronic circuitry application of the battery; the specific power, the battery material extruding; and conforming the size of the microscopic battery.

With respect to claims 103, 108, 111, 116, 118, 120:

Knight et al disclose an electrolyte may be produced in a known way such as mixing materials to obtain a solid solution which is subsequently extruded into a thin film (col 4, lines 20-25). Knight et al further disclose that this maybe important in application of microbatteries for example, in microelectronic circuitry (col 4, lines 30-36).

Knight et al also disclose that spin casting of films from an electrolyte material is also possible; and further processing steps may be desirable in order to define the spatial extent of, or

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area covered by, the electrolyte film. This maybe important in application of microbatteries, for example, in microelectronic circuitry. Known techniques common to microelectronics manufacture may be used including methods common to resist patterning (col 4, lines 29-38).

In view of the above, it would have been obvious to one skilled in the art at the time the invention was made to extrude the battery components of the microbattery of Bates et al as Knight et al teach that this processing step may be desirable in order to define the spatial extent, or area covered by the material films and this maybe important in application of microbatteries, for example, in microelectronic circuitry.

In view of the above, it would have been obvious to one skilled in the art at the time the invention was made to make the battery of Bates having the specific standardized microcircuitry application, conforming size and shape characteristic et al as it is taught that the battery can be fabricated to any specified size or shape to meet the requirements of a particular application. Accordingly, the amount of energy stored and/or delivered by the battery is generally directly related to its size and weight; as well as the performance of thin-film batteries is critically limited by the properties of the chosen electrolyte and the performance is also very dependent on formation of the cathode. Thus, if a larger battery were deposited over the unused area of the package, the capacity and current density of the battery could be increased. Hence, with suitable scaling of process parameters, the fabrication of high energy thin-film microbatteries is permitted wherein the capacity of the overall cell is based on combined masses of the cathode, electrolyte and anode allowed by the size of the battery; and where the manufactured battery is tested, comparably measured, or adjusted to a prototype battery which provides the standard to ascertain the requisite operating degree or to meet the operational condition of the specific conformed

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battery. Further, this is also a well-known industrial technique used to either to scale-up or scale-down the manufacture of any device.

With respect to the specific power, it would be obvious to make a microscopic battery having the specific power because Bates et al teach how the performance of the electrochemical energy storage device can be modified by employing distinct electrolytes. Accordingly, energy storage devices having very high energy per unit volume can be created by varying the electrolyte employed therein. Further, the use of electrolytes involves attempts to reduce package size while increasing the electrical energy storage capacity because there continues to be a requirement for efficient, high power density electrical storage devices which can withstand the rigors of continuous use and virtually unlimited cycling and those of ordinary skill in the art recognize that the performance of microbatteries is critically limited by the properties of the chosen electrolyte.

Allowable Subject Matter

3. The following is a statement of reasons for the indication of allowable subject matter: a reasonable search for the prior art failed to reveal or fairly suggest what is instantly claimed, particularly: a microfabricated battery comprising the specific micro-sized electrodes and electrolyte and comprising an area as small as one square micron (claim 110).

4. Claim 110 is allowed.

Response to Arguments

5. Applicant's arguments with respect to claims 103-109 and 111-121 have been considered but are moot in view of the new ground(s) of rejection.

6. Additionally, applicant's arguments filed on: i) 12/11/02 (amendment B) and 12/20/02 (amendment C); and ii) as part of all declarations filed on 12/02/02, 12/09/02, and 12/17/02 (a total of 4 papers including two (2) declarations of D.E. Reisner and R.M. LaFollette, and two (2) errata documents, respectively) have been fully considered but they are not persuasive. Even though a new ground of rejection has been set forth in this office action, the examiner wishes to address certain issues raised in the arguments presented in the foregoing declarations with respect to the '126 reference and the '422 reference (because the rejections over Santini, Jr et al'861 and Arledge et al'941 have been overcome):

a) as to argument the term "microbattery" is not universal and/or the term "thin-film batteries" does not equate applicant's wording, the examiner points out that although the '126 reference does not provide a clear definition of the term "microbattery" or thin-film batteries", the instant claims also fail to further specify, equate or limit the particular dimension degree or magnitude which is intended to recite by the term "microscopic", "microsize", "microfabrication" and the likes. *It appears that applicants are using the prefix "micro" to simply indicate a general structural dimension as the '126 reference does. That is, used for or involving minute quantities or variations only without specifically setting forth a limited size.*

b) with respect to the argument that Bates' battery is not made by lithography, the examiner directs applicant's attention to col 2, lines 12-25 of the '126 reference, wherein is

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stated that the battery area can be varied from sizes achievable with present lithographic techniques, thus a lithographic techniques is employed on the battery structure.

c) in response to applicant's argument that "*it would have to be attached as an oversized battery using external conductors or leads*", the fact that applicant has recognized another advantage/disadvantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

d) as to the electro-optical device, it is asserted that the '126 reference enables the use of an electrochemical battery throughout its disclosure as the '126 reference disclose that "a battery is one of two kinds of electrochemical devices that convert the energy released in chemical reaction directly into electrical energy" (col 1, lines 40-43). Accordingly, the reference clearly enables the use of the electrochemical battery.

e) regarding the argument that Bates et al's electrode are not microfabricated, the examiner again direct applicant's attention to col 2, line 52-55 wherein is stated that the Bates et al's invention includes a novel cathode having a microstructure providing excellent charge/discharge properties. Thus, the reference certainly encompasses microfabrication of electrodes.

f) with respect to the argument that Bates' battery does not satisfy the long unsatisfied need for a battery having a unisize relationship with microcircuits, it is noted that the '126 reference suggests (col 2, lines 8-11) that the small batteries might be scaled down for microelectronic applications, a size that is many times larger than the semiconductor chip on

which they are used. Thus, it discloses that the area of the battery can be varied to smaller achievable sizes.

g) on the matter of how a microscopic amount of electrolyte could be used in the context of MEMs compatibility, it is noted that even though the prior art does not expressly disclose so, it is an implicit teaching because one of ordinary skill in the art would obviously understand that if both electrode structures are microfabricated to a unique and particular size, the same also must be done to the electrolyte structure in order to meet mechanical and size structural requirement of the battery per se. Thus, the size of the battery electrodes must, in fact, be commensurate to the size of the electrolyte.

h) as to the method limitation i.e. the sacrificial material or etching, it is asserted that method limitations in a product claim do not patentable distinguish the product.

i) as to the energy requirement of the battery, it is asserted that the both references expresses that the area of the battery can be varied to different sizes to provide a wide range in battery capacity. Thus, the reference does encompass a relationship between specific battery dimension and specific energy output and capacity delivered so as to avoid battery designs not supplying a high energy, high current microbattery with its appropriate scaled down characteristic.

j) in response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the

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applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

k) In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the reference can be combined because they both discuss analogue subject matter, have a similar chemical system and encompass the use of microcircuitry along with battery matters.

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

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however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Raymond Alejandro whose telephone number is (703) 306-3326.

The examiner can normally be reached on Monday-Thursday (8:30 am - 7:00 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's primary examiner, Steve Kalafut can be reached on (703) 308-0433. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Raymond Alejandro
Examiner
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